

# THE CRYSTALMASTER

**Crystal Device Catalogue 2005.10**

# End to End EPSON TOYOCOM

The development of our ubiquitous network society has caused a diversification of applications and has increased the demand for high-level quartz devices in terms of quality, quantity, and function.

The Quartz Device Operations Division of SEIKO EPSON CORPORATION (EPSON) and TOYO COMMUNICATION EQUIPMENT CO.,LTD.(TOYOCOM) were integrated on October 1,2005 to establish a new company, EPSON TOYOCOM CORPORATION, to meet these market and customer demands.

Each company contributes its own strength; EPSON holds a strong presence in consumer products and TOYOCOM is strong in industrial products. The consolidation of these two companies in a new company that provides advanced expertise with a wide range of products for terminals and infrastructure to our

customers.

Quartz device have become crucial in the network environment where products are increasingly intended for broadband, ubiquitous applications and where various types of terminals can transfer information almost immediately via LAN and WAN on a global scale. EPSON TOYOCOM CORPORATION addresses every single aspect within a network environment. The new corporation offers "end-to-end" solutions to problems arising with products for consumer use, such as core network systems and automotive systems.

## PROMOTION OF ENVIRONMENTAL MANAGEMENT SYSTEM CONFORMING INTERNATIONAL STANDARD

At EPSON TOYOCOM, all environmental initiatives operate under the Plan-Do-Check-Action(PDCA) cycle designed to achieve continuous improvements. The environmental management system (EMS) operates under the ISO 14001 environmental management standard.

In May 2001, all of our major manufacturing and non-manufacturing sites, in Japan and overseas, completed the acquisition of ISO 14001 certification. In the future, new group companies will be expected to acquire the certification around the third year of operations.

ISO 14000 is an international standard for environmental management that was established by the International Standards Organization in 1996 against the background of growing concern regarding global warming, destruction of the ozone layer, and global deforestation.

## WORKING FOR HIGH QUALITY

EPSON TOYOCOM quickly began working to acquire company-wide ISO 9000 series certification, and has acquired ISO 9001 or ISO 9002 certification with all targeted products manufactured in Japanese and overseas plants.

The Quartz Device Operations Division (In Japan, EPM and SZE) have acquired QS-9000 certification, which are of higher Level. Also QS-9000 and TS 16949 certification, which is of higher level, has been acquired.

QS-9000 is an enhanced standard for quality assurance systems formulated by leading U.S. automobile manufacturers based on the international ISO 9000 series.

ISO/TS 16949 is a global standard based on QS-9000, a severe standard corresponding to the requirements from automobile industry.

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- These products are intended for general use in electronic equipment. When using them in specific applications that require extremely high reliability such as applications stated below, it is required to obtain the permission from EPSON TOYOCOM in advance.  
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/ Medical instruments to sustain life / Submarine transmitters / Power stations and related / Fire work equipment and security equipment  
/ traffic control equipment / and others requiring equivalent reliability.
- In this new crystal master for EPSON TOYOCOM, product code and marking will still remain as previously identified prior to the merger. Due to the on going strategy of gradual unification of part numbers, please review product code and marking as they will change during the course of the coming months.  
We apologize for the inconvenience, but we will eventually have a unified part numbering system for Epson Toyocom which will be user friendly.

# CONTENTS

•FREQUENCY RANGE LIST .....	2 ~ 5
•PACKAGE DIMENSIONS LIST .....	6 ~ 8

## CRYSTAL UNIT / RESONATOR

•kHz RANGE CRYSTAL UNIT (TUNING FORK) .....	9 ~ 14
•MHz RANGE CRYSTAL UNIT (AT) .....	15 ~ 24
•RESONATOR (SAW) .....	25 ~ 27

## OSCILLATOR

•CRYSTAL OSCILLATOR	
SPXO .....	28 ~ 42
PROGRAMMABLE .....	43 ~ 50
SPREAD SPECTRUM .....	51
LOW JITTER (SAW) .....	52 ~ 56
HIGH-STABILITY .....	57 ~ 63
MULTI-OUTPUT .....	64 ~ 66
•VCXO .....	67 ~ 90
•TCXO .....	91 ~ 98
•OCXO .....	99 ~ 103
•RUBIDIUM .....	104 ~ 105
•PLL MODULE .....	106

## REAL TIME CLOCK MODULE

•SERIAL INTERFACE .....	107 ~ 120
•PARALLEL INTERFACE .....	121 ~ 124

## FILTER

•MONOLITHIC CRYSTAL FILTER (MCF) .....	125 ~ 131
•SAW FILTER .....	132 ~ 146

## SENSOR

•GYRO SENSOR .....	148
•TEMPERATURE SENSING CRYSTAL .....	149
•PRESSURE SENSING CRYSTAL .....	150

## OPTICAL DEVICE

•1/4, 1/2 WAVE PLATE .....	151
•DICHROIC PRISM .....	152
•DICHROIC MIRROR/PLATE .....	153
•GRATING .....	154
•DICHROIC FILTER .....	154
•OPTICAL LOW PASS FILTER (OLPF) .....	155
•HEAT SINKPLATE .....	156
•ETALON FILTER .....	156

## APPLICATION GUIDE

•WORKING FOR Pb FREE PRODUCTS .....	157 ~ 158
•HANDLING PRECAUTIONS .....	159 ~ 161
•PRECAUTIONS IN DESIGNING OSCILLATION CIRCUITS .....	162
•OUTPUT WAVE FORM AND TEST CIRCUIT .....	163 ~ 166
•STANDARD PACKING SPECIFICATIONS .....	167 ~ 169
•GLOSSARY .....	170 ~ 172
•MANUFACTURING PLANT .....	173

# TABLE OF FREQUENCY RANGE

## ■kHz range crystal unit (Tuning Fork)

Page	Frequency		20 kHz	32 kHz	100 kHz	200 kHz	300 kHz
	Model						
10	FC-135			32 kHz	77.5 kHz		
	FC-145			●32.768 kHz			
	FC-255						
11	MC-146			32 kHz	100 kHz		
	MC-156						
12	MC-306		20 kHz			165 kHz	
	MC-405/406		20 kHz			165 kHz	●307.2 kHz
13	MC-30A		20 kHz			165 kHz	
14	C-001R						
	C-002RX						
	C-004R						
	C-005R						
	C-2-TYPE		20 kHz			165 kHz	●307.2 kHz
	C-4-TYPE			32 kHz		120 kHz	●192 kHz

## ■MHz range crystal unit (AT)

Page	Frequency		1 MHz	10 MHz	20 MHz	64 MHz
	Model					
15	TSX-2520				16 MHz	54 MHz
16	TSX-3225			12 MHz		54 MHz
17	FA-238				16 MHz	50 MHz
	FA-238V			12 MHz	15.999 MHz	
18	TSX-4025			12 MHz		32 MHz
19	TSX-5032			10 MHz		32 MHz
20	TSX-6035			10 MHz		32 MHz
21	FA-365			●12 MHz		
				14 MHz		41 MHz
22	MA-306			●14.31818 MHz		
				17.734 MHz		41 MHz
23	MA-406		4 MHz			64 MHz*
	MA-505 / 506					
24	CA-301					

\* 8.0 MHz < f < 8.2 MHz : Unavailable.  
For frequencies less than 5.5MHz, please refer to the frequency list on each data sheet.

## ■Resonator (SAW)

Page	Frequency		200 MHz	500 MHz	700 MHz	1 GHz
	Model					
25	NS-32R		312 MHz			870 MHz
	FS-335		300 MHz			870 MHz
	FS-555		230 MHz		500 MHz	
26	FS-585		300 MHz		500 MHz	

# TABLE OF FREQUENCY RANGE

## ■ Oscillator

### ► SPXO

Page	Frequency		1 Hz	100 kHz	1 MHz	50 MHz	100 MHz	200 MHz	500 MHz	800 MHz
	Model									
30	SG-3030LC/JF/JC									
	SG-3040LC/JC									
	SG-3032JC									
31	SG-310 Series				2 MHz		48 MHz			
32	SG-350/550 Series				1 MHz		48 MHz			
33	TCO-7106X1A/7107X1A				1.5 MHz		75 MHz			
34	TCO-708x Series				1.5 MHz			135 MHz		
35	TCO-7116 H1A				50 MHz			213 MHz		
36	SG-710 Series				1.8 MHz			125 MHz		
37	SG-645 Series				32.001 MHz			135 MHz		
38~39	SG-636 Series				2.21675 MHz			135 MHz		
40~41	SG-615 Series				1.025 MHz			135 MHz		
	SG-531 Series									
	SG-51 Series				1.025 MHz			66.6667 MHz		
42	TCO-711A7				1.5 MHz			100 MHz		

### ► Low Jitter (SAW)

Page	Frequency		1 Hz	100 kHz	1 MHz	50 MHz	100 MHz	200 MHz	500 MHz	800 MHz
	Model									
52	XG-1000CA/CB Series					50 MHz		170 MHz		
53	EG-2021CA					62.5 MHz		170 MHz		
55	EG-2121CA	LV-PECL (Differential)				53.125 MHz		500 MHz		
		LV-DS				53.125 MHz		700 MHz		
	EG-2102CA	LV-PECL (Differential)					100 MHz		700 MHz	
		LV-DS					53.125 MHz		700 MHz	
56	EG-2101CA					62.5 MHz		400 MHz		
54	EG-2002CA					62.5 MHz		170 MHz		
53	EG-2001CA					106.25 MHz		170 MHz		

### ► Spread Spectrum

Page	Frequency		1 Hz	100 kHz	1 MHz	50 MHz	100 MHz	200 MHz	500 MHz	800 MHz
	Model									
51	SG-9001 Series					10 MHz		166 MHz		

### ► High-Stability

Page	Frequency		1 Hz	100 kHz	1 MHz	50 MHz	100 MHz	200 MHz	500 MHz	800 MHz
	Model									
57	HG-2150CA					1.0 MHz		80 MHz		
58	HG-8002JA					1.0 MHz		125 MHz		
59	TCO-391B/C Series					8.0 MHz		78 MHz		
60	TCO-393F							100 MHz		500 MHz
61	TCO-3110 Series					60 MHz				800 MHz
62	TCO-3131					60 MHz				700 MHz
63	TCO-743A7/HC7					1.5 MHz				60 MHz

### ► Multi-Output

Page	Frequency		1 Hz	100 kHz	1 MHz	50 MHz	100 MHz	200 MHz	500 MHz	800 MHz
	Model									
64	MG-5020JE									
65	MG-5100SA									

## ■ Rubidium

Page	Frequency		1 Hz	100 kHz	1 MHz	50 MHz	100 MHz	200 MHz	500 MHz	800 MHz
	Model									
104	Rb-7000									
105	Rb-2120GE									

## ■ PLL MODULE

Page	Frequency		1 Hz	100 kHz	1 MHz	50 MHz	100 MHz	200 MHz	500 MHz	800 MHz
	Model									
106	TCM-2021 Series					30 MHz				230 MHz

■TCXO

Page	Model	Frequency	1 Hz	100 kHz	1 MHz	50 MHz	100 MHz	200 MHz	500 MHz	800 MHz
92	TG-3530SA		●32.768 kHz							
93	TG-5001LA				10 MHz	40 MHz				
94	TG-5010LH				10 MHz	38.4 MHz				
95	TCO-5890 Series				10 MHz	40 MHz				
96	TCO-5860 Series				8 MHz	40 MHz				
97	TCO-5850 Series				16 MHz	30 MHz				
98	TCO-5060/5160 Series				10 MHz	51.84 MHz				

■VCXO

Page	Model	Frequency	1 Hz	100 kHz	1 MHz	50 MHz	100 MHz	200 MHz	500 MHz	800 MHz
73	VG-1201CA			1.0 MHz			80 MHz			
68	TCO-7106Z1Z			1.5 MHz		52 MHz				
70	TCO-7116X1V			1.5 MHz		55 MHz				
69	TCO-7116Z1Z4				60 MHz		80 MHz			
74	TCO-291B/C Series			8 MHz			125 MHz			
75	TCO-291J/X				60 MHz		230 MHz			
76	TCO-293 Series				60 MHz				800MHz	
77	TCO-294J					100 MHz			690 MHz	
78	TCO-296 Series					100 MHz			690 MHz	
79	TCO-2000/2100 Series			8 MHz			125 MHz			
80	TCO-2106/2107			1.0 MHz			80 MHz			
81	TCO-2110 Series				60 MHz				800MHz	
82	TCO-2131				60 MHz				700MHz	
83	TCO-2152				77 MHz			230 MHz		
84	TCO-726BVX/DVX			1.5 MHz		34 MHz				
86	VG-4030JA			2.0 MHz		28.6363 MHz				
85	TCO-7026X1V2				34 MHz		67 MHz			
87	TCO-756BVX7/DVX7			1.5 MHz		40 MHz				
72	VG-4231CA			1.0 MHz		75 MHz				
88	TCO-734A/735 Series				60 MHz			230 MHz		
89	TCO-7302 Series			8 MHz		52 MHz				
71	VG-4231CE			12 MHz		48 MHz				

■OCXO

Page	Model	Frequency	1 Hz	100 kHz	1 MHz	50 MHz	100 MHz	200 MHz	500 MHz	800 MHz
99	TCO-6602				10 MHz	40 MHz				
100	TCO-6730				●5 MHz ●10 MHz					
101	TCO-676				10 MHz	20 MHz				
102	TCO-679				10 MHz	20 MHz				
103	TCO-6920				●10 MHz					

■Crystal Oscillator

▶Programmable Crystal Oscillator

Page	Model	Frequency	Supply voltage	Frequency tolerance Operating Temperature	1 MHz	50 MHz	100 MHz	125 MHz
43	SG-8002CE	PT/ST PH,SH	4.5 V to 5.5 V	B,C M	1.0 MHz			125 MHz
		PC SC	3.0 V to 3.6 V (2.7 V to 3.6 V)	B,C,M	1.0 MHz			125 MHz
44	SG-8002LA SG-8002LB	PH,SH	5.0 V±0.5 V	B,C M,L	1.0 MHz		80 MHz	
		PC,SC	3.3 V±0.3 V	B,C,M,L	1.0 MHz			125 MHz
45	SG-8002JF	PT/ST PH,SH	4.5 V to 5.5 V	B,C M	1.0 MHz			125 MHz
		PC SC	3.0 V to 3.6 V (2.7 V to 3.6 V)	B,C,M	1.0 MHz			125 MHz
45~47	SG-8002CA SG-8002JA SG-8002DB SG-8002DC	PT/ST PH,SH	4.5 V to 5.5 V	B,C M	1.0 MHz			125 MHz
		PC,SC	3.0 V to 3.6 V (2.7 V to 3.6 V)	B,C,M	1.0 MHz			125 MHz
46	SG-8002JC	PT/ST PH,SH	4.5 V to 5.5 V	B C	1.0 MHz			125 MHz
		PC,SC	3.0 V to 3.6 V (2.7 V to 3.6 V)	B C	1.0 MHz			125 MHz

Frequency tolerance: B:±50×10<sup>-6</sup>(-20 °C to +70 °C), C:±100×10<sup>-6</sup>(-20 °C to +70 °C), M:±100×10<sup>-6</sup>(-40 °C to +85 °C), L:±50×10<sup>-6</sup>(-40 °C to +85 °C)

# TABLE OF FREQUENCY RANGE

## ■ Monolithic Crystal Filter (MCF)

Page	Model	Frequency		
		100 MHz	200 MHz	500 MHz
126 ~ 127	TF2-D0AD6			
126 ~ 127	TS3-D0A31		●130.05 MHz	
126 ~ 127	TF3-J3DC5		●183.6 MHz	
126 ~ 127	TF3-Q3GC1			●243.95 MHz
128 ~ 129	TS2-21B01	●21.4 MHz		
128 ~ 129	TS2-21B02	●21.7 MHz		
128 ~ 129	TS2-45A01	●45 MHz		
128 ~ 129	TS3-45A01	●45 MHz		
128 ~ 129	TF3-73BA1	●73.35 MHz		
128 ~ 129	TF4-73BA2	●73.35 MHz		
130	TF4-71GX2	●71 MHz		
131	TF2-W1GC1		310 MHz	320 MHz

## ■ SAW Filter

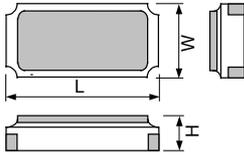
Page	Model	Frequency			
		300 MHz	500 MHz	1000 MHz	2000 MHz
136	FF-32N	300 MHz	500 MHz		
134	FF-555	300 MHz	500 MHz		
135	FF-585	300 MHz	500 MHz		
142 ~ 143	TQS-535AB-7G			●881.5 MHz	
142 ~ 143	TQS-516EA-7G			●881.5 MHz	
142 ~ 143	TQS-530S-7G			●836.5 MHz	
142 ~ 143	TQS-539A-7G			●906 MHz	
144 ~ 145	TQS-465AA-7R	●183.6 MHz			
144 ~ 145	TQS-663AA-7R	●183.6 MHz			
144 ~ 145	TQS-477AA-7R	●190 MHz			
137	TQS-557AA-7R			●869 MHz	
137	TQS-566AA-7R		●433.92 MHz		
137	TQS-542AA-7R			●915 MHz	
138 ~ 139	TQS-954EA-7R			●1575.42 MHz	
138 ~ 139	TQS-537AB-7G			●1575.42 MHz	
138 ~ 139	TQS-949AD-7G			●1575.42 MHz	
140	TQS-457A-7R		●374 MHz		
140	TQS-471BB-7R		●374 MHz		
132 ~ 133	TQS-830A-7R		●429.55 MHz		
132 ~ 133	TQS-568AA-7R		●428 MHz		
132 ~ 133	TQS-570AA-7R		●315 MHz		
141	TQS-879A-7R			●903.5 MHz	
146	TQS-472BA-7R		●380 MHz		●926.5 MHz
146	TQS-474AA-7R	●190 MHz			

TABLE OF DIMENSIONS

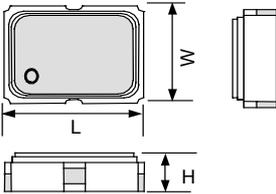
■ SMD Type

● SON

Glass Lid type

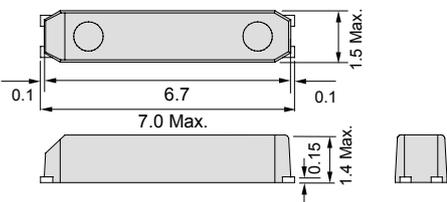


Metal Lid type

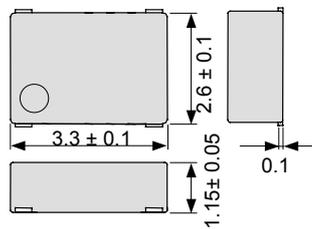


Subject	Model	Dimension (mm)			Pin
		L	W	H	
Crystal Unit	FC-135	3.2±0.1	1.5±0.1	0.8±0.1	2
	FC-145	4.1±0.1	1.5±0.1	0.8±0.1	2
	FC-255	4.9±0.1	1.8±0.1	0.8±0.1	2
	TSX-2520	2.5±0.15	2.0±0.15	0.55 Max.	4
	TSX-3225	3.2±0.15	2.5±0.15	0.6 Max.	4
	FA-238 / 238V	3.2±0.1	2.5±0.1	0.6±0.1	4
	TSX-4025	4.0±0.15	2.5±0.15	0.7 Max.	4
	TSX-5032	5.0±0.15	3.2±0.15	0.8 Max.	4
	TSX-6035	6.0±0.15	3.5±0.15	1.0 Max.	4
	FA-365	6.0±0.2	3.5±0.2	1.4 Max.	2
SAW Resonator	FS-335 / NS-32R	3.8±0.15	3.8±0.15	0.98±0.15	6
	FS-555 / 585	4.8±0.2	5.2±0.2	1.5±0.2	8
Crystal Oscillator	SG-310 / SG-8002CE	3.2±0.2	2.5±0.2	1.05±0.15	4
	TCO-7106X1A / 7107X1A	5.0±0.2	3.2±0.2	1.0±0.2	4
	TCO-708x Series	7.0±0.2	5.0±0.2	1.6±0.2	4
	TCO-7116H1A	7.0±0.2	5.0±0.2	1.6±0.2	6
	SG-710	7.3±0.2	4.8±0.2	1.3±0.1	4
	SG-8002CA	7.0±0.2	5.0±0.2	1.5 Max.	4
	HG-2150CA	7.0±0.2	5.0±0.2	1.5 Max.	4
	SG-9001CA	7.0±0.2	5.0±0.2	1.4±0.1	6
	XG-1000CA	7.0±0.2	5.0±0.2	1.2±0.2	4
	XG-1000CB	5.0±0.2	3.2±0.2	1.1±0.15	4
	EG-20**CA	7.0±0.2	5.0±0.2	1.2±0.2	4
	EG-21**CA	7.0±0.2	5.0±0.2	1.2±0.2	6
	VCXO	VG-4231CE	3.2±0.2	2.5±0.2	1.05±0.15
TCO-7106Z1Z		5.0±0.2	3.2±0.2	1.2±0.2	6
VG-4231CA / VG-1201CA		7.0±0.2	5.0±0.2	1.4±0.1	6
TCXO	TCO-7116X1V / Z1Z4	7.0±0.2	5.0±0.2	1.6±0.2	6
	TCO-5890 Series	2.5±0.2	2.0±0.2	1.0 Max.	4
	TCO-5850 / 5860 Series	3.2±0.2	2.5±0.2	1.0 Max.	4
SAW Filter	TCO-5060 / 5160 Series	7.0±0.2	5.0±0.2	2.0±0.2	6
	TQS-535AB-7G / TQS-537AB-7G	2.5±0.1	2.0±0.1	0.8±0.2	5
	TQS-954EA-7R	2.5±0.1	2.0±0.1	1.15 Max.	4
	TQS-516EA-7G / TQS-530S-7G	2.5±0.1	2.0±0.1	0.8±0.2	4
	TQS-539A-7G / TQS-949AD-7G	2.5±0.1	2.0±0.1	0.8±0.2	4
	TQS-570AA-7R	3.0±0.1	3.0±0.1	1.11±0.2	6
	TQS-557AA-7R / TQS-566AA-7R	3.0±0.1	3.0±0.1	1.11±0.2	6
	TQS-542AA-7R / TQS-471BA-7R	3.0±0.1	3.0±0.1	1.15 Max.	8
	TQS-477AA-7R	3.0±0.1	3.0±0.1	1.15 Max.	8
	TQS-568AA-7R	3.8±0.2	3.8±0.2	1.25±0.15	6
	TQS-879A-7R	3.8±0.2	3.8±0.2	1.25±0.15	8
	FF-32N	3.8±0.15	3.8±0.15	0.98±0.15	6
	FF-555 / 585	4.8±0.2	5.2±0.2	1.5±0.2	8
	TQS-457A-7R / TQS-830A-7R	5.2±0.2	4.5±0.2	1.55±0.15	8
	TQS-465AA-7R	6.0±0.13	3.5±0.13	1.15±0.2	10
	TQS-663AA-7R	7.0±0.2	5.0±0.2	1.57±0.2	10
	TQS-472BA-7R / TQS-474AA-7R	7.0±0.2	5.0±0.2	1.5 Max.	10
	MCF	TF2-D0AD6	2.5±0.05	2.0±0.05	0.9±0.15
TF3-J3DC5 / TF3-Q3GC1 / TF2-W1GC1		3.0±0.1	3.0±0.1	0.9±0.15	8
TS3-D0A31		3.8±0.1	3.8±0.1	1.0±0.2	8
TS2-21B01 / TS2-21B02		7.0±0.2	5.0±0.2	1.3±0.2	6
TS2-45A01 / TS3-45A01 / TF3-73BA1		7.0±0.2	5.0±0.2	1.1±0.2	6

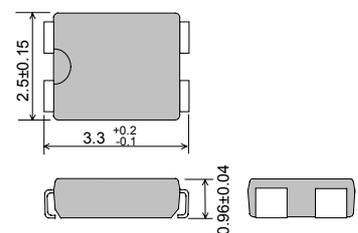
● SON (Crystal Unit)  
MC-146



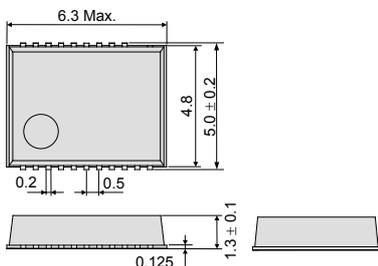
● SON (Crystal Oscillator)  
SG-350, SG-8002LA, TG-5001LA



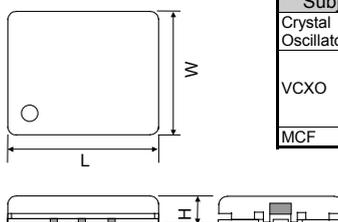
● SON (TCXO)  
TG-5010LH



● SON (Real time clock module:NB Package)  
RX-\*\*\*\*NB / RTC-\*\*\*\*NB



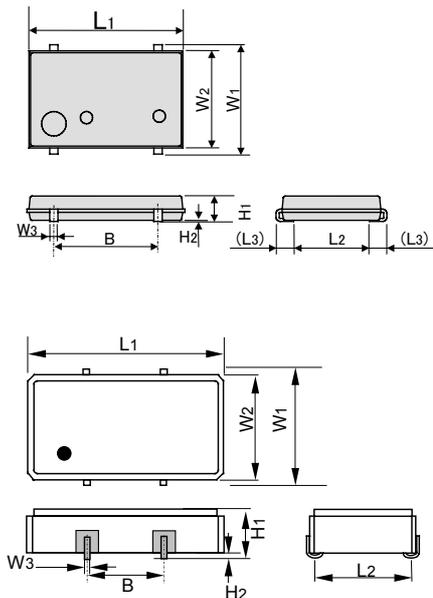
● SON (Metal Cap Type)



Subject	Model	L	W	H	Pin
Crystal Oscillator	TCO-393F	20.0±0.5	12.5±0.5	6.0 Max.	14
VCXO	TCO-294J	11.4±0.2	9.6±0.2	2.0 Max.	6(8)
	TCO-296 Series	11.4±0.2	9.6±0.2	2.0 Max.	6
	TCO-2152	7.0±0.3	5.2±0.3	2.0 Max.	6
MCF	TCO-293 Series	20.0±0.5	12.5±0.5	6.0 Max.	14
	TF4-71GX2	26.0±0.3	16.0±0.3	5.0±0.3	12

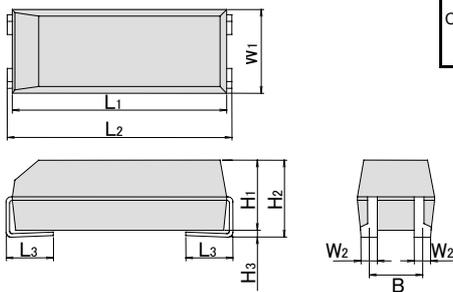
■ SMD Type

● SOJ / VSOJ



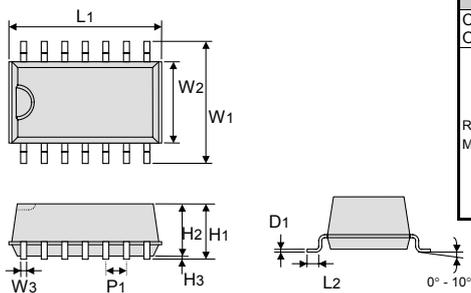
Subject	Model	L1	L2	(L3)	W1	W2	W3	H1	H2	B	Pin
Crystal Unit	MC-156	7.1 Max.	1.6	(0.75)	3.3 Max.	2.5	0.4	1.5 Max.	—	5.08	4
	MC-306 / 30A MA-306	8.0 Max.	1.9	(0.9)	3.8 Max.	3.2	0.5	2.54 Max.	—	5.5	4
	MA-406	11.7 Max.	2.1	(1.2)	4.8 Max.	4.0	0.7	3.7 Max.	—	9.6	4
Crystal Oscillator	SG-550 SG-**LB	5.0 ±0.2	2.5	(0.35)	3.2 ±0.2	2.8	1.0	1.2 Max.	0.0 Min.	2.54	4
	SG-645 SG-**JF	7.1 ±0.2	3.8	(0.75)	5.1 ±0.2	4.6 ±0.2	0.4	1.5 Max.	0.0 Min.	5.08	4
	SG-636 SG-**JC	10.5 Max.	3.6	(1.0)	5.8 Max.	5.0	0.51	2.7 Max.	0.05 Min.	5.08	4
	SG-615 SG-**JA HG-**JA	14.0 Max.	7.62	—	9.8 Max.	8.65	0.51	4.7 Max.	0.25 Min.	5.08	4
	MG-**JE	7.0 ±0.3	4.5	(0.75)	6.0 ±0.2	5.4	0.22	1.5 Max.	0.0 Min.	0.65	20
	TCO-3110 Series TCO-3131	13.9 ±0.1	7.62	—	9.8 Max.	8.75	0.5	4.7 Max.	0.25 Min.	2.54	6
	VG-**JA	14.0 Max.	7.62	—	9.8 Max.	8.65	0.51	4.7 Max.	0.25 Min.	5.08	4
VCXO	TCO-2000 Series TCO-2100 Series TCO-2110 Series TCO-2131	13.9 ±0.1	7.62	—	9.8 Max.	8.75	0.5	4.7 Max.	0.25 Min.	2.54	6
	TCO-726 TCO-7026	14.22 Max.	6.99	—	9.14 Max.	8.67	0.54	5.0 Max.	—	5.08	4
										2.54	6
Real time Clock Module	SG-**LC RX-**LC	3.6 ±0.2	2.0	(0.4)	2.8 ±0.2	2.4	0.22	1.2 Max.	0.0 Min.	0.5	12
	RX-**JE RTC-**JE	7.0 ±0.3	4.5	(0.75)	6.0 ±0.2	5.4	0.22	1.5 Max.	0.0 Min.	0.65	20

● SOJ (Crystal Unit)



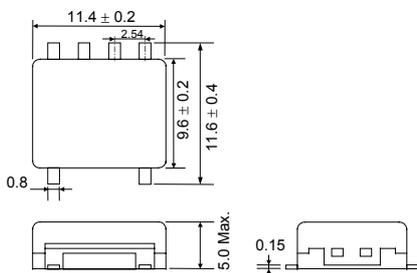
Subject	Model	L1	L2	L3	W1	W2	B	H1	H2	H3
Crystal Unit	MC-405 / 406	9.6	10.41 Max.	2.54	4.06 Max.	0.51	2.29	3.15	3.6 Max.	0.2 Min.
	MA-505 / 506	12.7	13.46 Max.	2.54	5.08 Max.	1.09	3.3	4.19	4.6 Max.	0.2 Min.

● SOP / VSOP

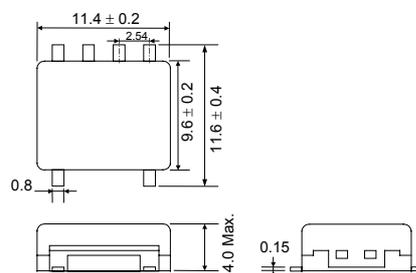


Subject	Model	L1	L2	W1	W2	W3	H1	H2	H3	D1	P1	Pin
Crystal Oscillator	MG-5100SA	10.1 ±0.2	0.6	7.4 ±0.2	5.0	0.35	3.2 ±0.1	3.1	0.05 Min.	0.15	1.27	14
	RTC-****SA RX-****SA RA-****SA											
Real time Clock Module	RTC-4543SB	11.4 ±0.2	0.6	7.8 ±0.2	5.4	0.4	2.0 Max.	1.8	0 Min.	0.15	1.27	18
	RTC-62423 RTC-72423	16.3 Max.	1.0	12.2 Max.	7.9	0.35	2.8 Max.	—	0.1 Min.	0.2	1.27	24
	RTC-7301SF	10.2 ±0.3	0.5	7.8 ±0.3	5.4	0.36	2.0 Max.	—	0 Min.	0.15	0.8	24

● SOP (Crystal Oscillator)  
TCO-391B / C Series, TCO-291B / C Series

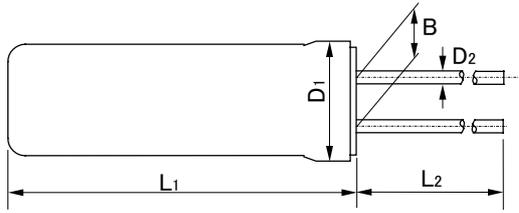


● SOP (VCXO)  
TCO-291J / X



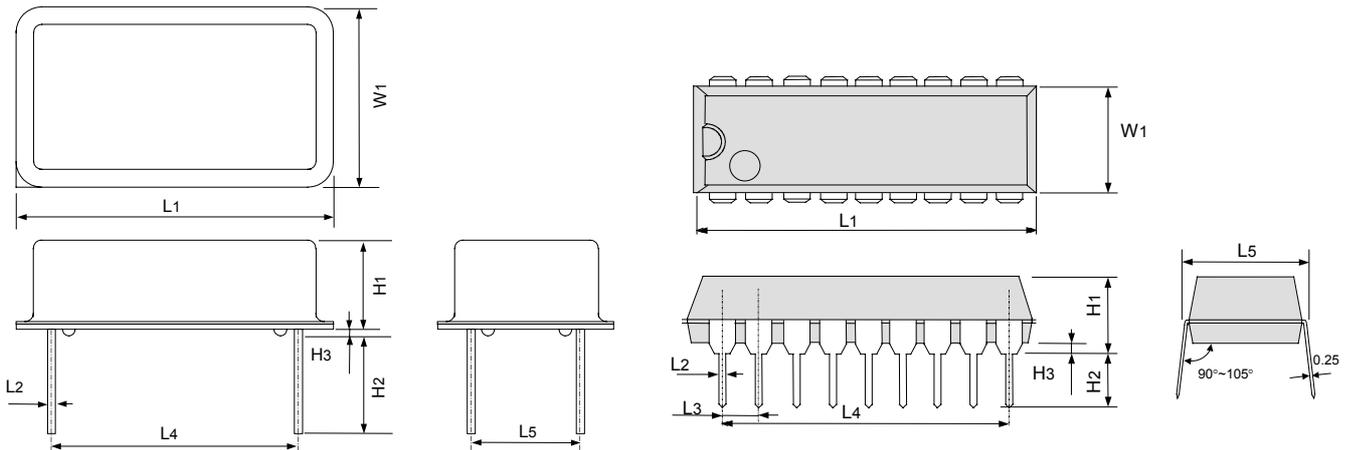
■ Dip Type

● Cylinder



Subject	Model	L <sub>1</sub>	L <sub>2</sub>	D <sub>1</sub>	D <sub>2</sub>	B
Crystal Unit	C-001R	8.0 Max.	9.0 Min.	Φ3.1 Max.	Φ0.3	1.1
	C-002RX / C-2-TYPE	6.0 Max.	4.0 Min.	Φ2.0 Max.	Φ0.2	0.7
	C-004R / C-4-TYPE	5.0 Max.	4.0 Min.	Φ1.5 Max.	Φ0.18	0.5
	C-005R	4.6 Max.	4.0 Min.	Φ1.2 Max.	Φ0.15	0.3
	CA-301	Over 5.5 MHz	8.9 Max.	9.5 Min.	Φ3.1 Max.	Φ0.3
	Under 5.5 MHz	9.3 Max.	9.5 Min.	Φ3.1 Max.	Φ0.3	1.1

● DIP



Subject	Model	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	L <sub>5</sub>	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>	W <sub>1</sub>	Pin
Crystal Oscillator	TCO-743A7/HC7 TCO-711A7	20.8 Max.	Φ0.46	—	15.24	7.62	7.11 Max.	4.0 Min.	0.79	13.2 Max.	4 Pin
	SG-51 SG-8002DB	19.8 Max.	0.51	—	15.24	7.62	5.3 Max.	2.54 Min.	0.2 Min.	6.36	4 Pin
	SG-531 SG-8002DC	13.7 Max.	0.51	—	7.62	7.62	5.3 Max.	2.54 Min.	0.2 Min.	6.6	4 Pin
	TCO-756BVX7/DVX7	20.8 Max.	Φ0.46	—	15.24	7.62	7.11 Max.	4.0 Min.	0.79	13.2 Max.	4 Pin
VCXO	TCO-734A TCO-735 Series TCO-7302 Series	21.0 Max.	Φ0.45	—	15.24	7.62	7.24 Max.	5.85 Min.	0.8 ±0.3	13.1 Max.	4 Pin
	TCO-6602	36.2 Max.	Φ0.8	—	25.4 ±0.2	17.8 ±0.2	20.0 Max.	4.5 Min.	0.5 to 1.0	27.2 Max.	5 Pin
OCXO	TCO-6730	51.0 Max.	Φ1.0	—	42.0 ±0.2	32.0 ±0.2	30.5 Max.	4.1 Min.	0.5	41.0 Max.	5 Pin
	TCO-676	25.4 Max.	Φ0.75	—	19.05 ±0.3	19.05 ±0.3	12.7 Max.	4.5 ±0.1	Inside H1	25.4 Max.	5 Pin
	TCO-679	20.3 ±0.5	Φ0.45	—	15.24 ±0.2	7.62 ±0.2	9.7 ±0.5	5.55 ±0.7	Inside H1	12.7 ±0.5	4 Pin
	TCO-6920	50.0 ±0.5	Φ1.0	—	40.64 ±0.3	40.64 ±0.3	25.0 ±0.5	5.0 ±1.0	Inside H1	50.0 ±0.5	5 Pin
	RTC-7301DG	23.1 Max.	0.46	2.54	20.32	7.62	4.2 Max.	2.54 Min.	0.2 Min.	6.3	18 Pin
Real time Clock Module	RTC-62421 RTC-72421	23.1 Max.	0.65	2.54	20.32	7.62	4.2 Max.	3.3 Min.	0.2 Min.	6.3	18 Pin



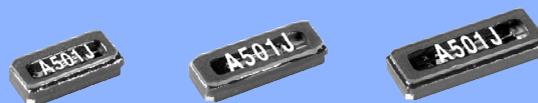
# Crystal Unit / Resonator

Category	Model	Actual size (mm) Typ.		Frequency range	Page.	
kHz Range Crystal Unit (Tuning fork)	FC-135		3.2×1.5×0.8t	32.768 kHz, 32 kHz to 77.5 kHz	10	
	FC-145		4.1×1.5×0.8t	32.768 kHz		
	FC-255		4.9×1.8×0.8t	32.768 kHz, 32 kHz to 100 kHz		
	MC-146		7.0×1.5×1.4t (Max.)	32.768 kHz, 32 kHz to 100 kHz	11	
	MC-156		7.1×3.3×1.5t (Max.)	32.768 kHz, 32 kHz to 100 kHz		
	MC-306		8.0×3.8×2.54t (Max.)	32.768 kHz, 20 kHz to 165 kHz	12	
	MC-405/406		10.41×4.06×3.6t (Max.)	32.768 kHz, 20 kHz to 165 kHz, 307.2 kHz		
	MC-30A			8.0×3.8×2.54t (Max.)	32.768 kHz, 20 kHz to 165 kHz	13
	C-TYPE				14	
	C-001R		φ3.1 Max.	32.768 kHz		
	C-002RX		φ2.0 Max.			
C-004R		φ1.5 Max.				
C-005R		φ1.2 Max.				
C-2-TYPE		φ2.0 Max.	20 kHz to 165 kHz, 307.2 kHz			
C-4-TYPE		φ1.5 Max.	32 kHz to 120 kHz, 192 kHz			
MHz Range Crystal Unit (AT)	TSX-2520 (High-stability)		2.5×2.0×0.55t (Max.)	16 MHz to 54 MHz	15	
	TSX-3225 (High-stability)		3.2×2.5×0.6t (Max.)	12 MHz to 54 MHz	16	
	FA-238V/238		3.2×2.5×0.6t	12 MHz to 50 MHz	17	
	TSX-4025 (High-stability)		4.0×2.5×0.7t (Max.)	12 MHz to 32 MHz	18	
	TSX-5032 (High-stability)		5.0×3.2×0.8t (Max.)	10 MHz to 32 MHz	19	
	TSX-6035 (High-stability)		6.0×3.5×1.0t (Max.)	10 MHz to 32 MHz	20	
	FA-365		6.0×3.5×1.4t	12 MHz, 14 MHz to 41 MHz	21	
	MA-306		8.0×3.8×2.54t (Max.)	14.31818 MHz, 17.734 MHz to 41 MHz	22	
	MA-406		11.7×4.8×3.7t (Max.)	4 MHz to 64 MHz	23	
	MA-505/506		13.46×5.08×4.6t (Max.)	4 MHz to 64 MHz		
	CA-301		φ3.1 Max.	4 MHz to 64 MHz	24	
Resonator (SAW)	NS-32R			312 MHz to 870 MHz	25	
	FS-335			300 MHz to 870 MHz		
	FS-555			230 MHz to 500 MHz		
	FS-585			300 MHz to 500 MHz	26	

**kHz RANGE CRYSTAL UNIT  
LOW PROFILE SMD**

**FC - 135 / 145 / 255**

- Frequency range : 32.768 kHz (32 kHz to 100 kHz)
- Thickness : 0.8 mm Typ.
- Overtone order : Fundamental
- Applications : Small communications devices
- Lead(Pb)-free : Contains Pb in sealing glass exempted by RoHS directive.



Actual size

FC-135

FC-145

FC-255

A501J

A501J

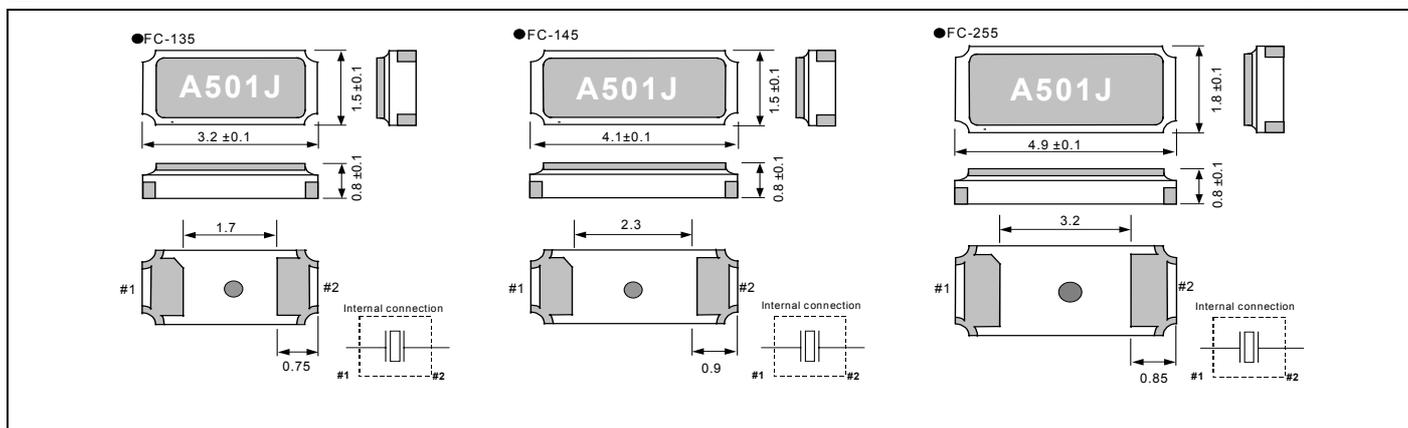
A501J

**Specifications (characteristics)**

Item	Symbol	Specifications				Remarks
		FC-135 / 145	FC-255	FC-135	FC-255	
Nominal frequency range	f	32.768 kHz		32 kHz to 77.5 kHz	32 kHz to 100 kHz	please contact us for inquiries Regarding available frequencies.
Temperature range	Storage temperature T_stg	-55 °C to +125 °C				Stored as bare product after unpacking
	Operating temperature T_use	-40 °C to +85 °C				
Level of drive	DL	0.5 μW Max.				
Frequency tolerance (standard)	f_tol	±20 × 10 <sup>-6</sup>		±50 × 10 <sup>-6</sup>	±100 × 10 <sup>-6</sup>	+25 °C, DL=0.1 μW Please ask tighter tolerance
Turnover temperature	Ti	+25 °C ±5 °C				
Parabolic coefficient	B	-0.04 × 10 <sup>-6</sup> / °C <sup>2</sup> Max.				
Load capacitance	CL	9 pF, 12.5 pF	7 pF, 12.5 pF	9 pF, 12.5 pF	7 pF, 12.5 pF	Please specify
Motional resistance (ESR)	R <sub>1</sub>	70 kΩ Max.	65 kΩ Max.	70 kΩ to 45 kΩ	70 kΩ to 30 kΩ	
Motional capacitance	C <sub>1</sub>	3.4 fF Typ.	2.0 fF Typ.	3.7 fF to 1.6 fF	2.3 fF to 0.6 fF	
Shunt capacitance	C <sub>0</sub>	1.0 pF Typ.	1.3 pF Typ.	1.3 pF to 0.5 pF	1.7 pF to 0.9 pF	
Frequency aging	f_age	±3 × 10 <sup>-6</sup> / year Max.				+25 °C, First year

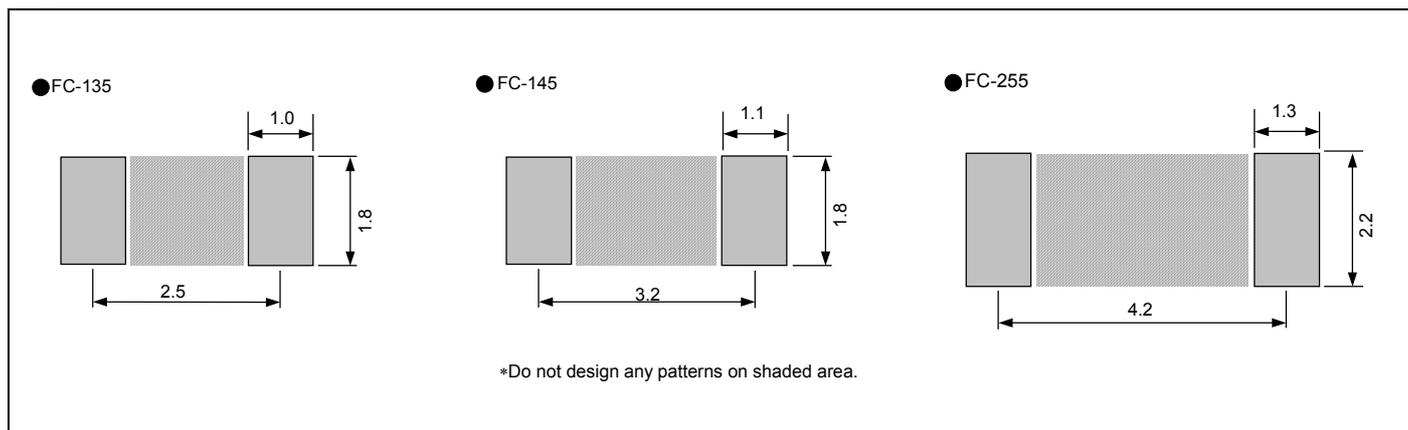
**External dimensions**

(Unit:mm)



**Footprint (Recommended)**

(Unit:mm)



## kHz RANGE CRYSTAL UNIT LOW PROFILE SMD

# MC - 146 / 156

- Frequency range : 32.768 kHz (32 kHz to 100 kHz)
- Thickness : 1.4 mm Max. (MC-146)  
1.5 mm Max. (MC-156)
- Overtone order : Fundamental
- Applications : Small communications devices
- Lead(Pb)-free : High melting temperature type solder (Pb85 %) exempted by RoHS directive.



Actual size

MC-146

MC-156

EA99

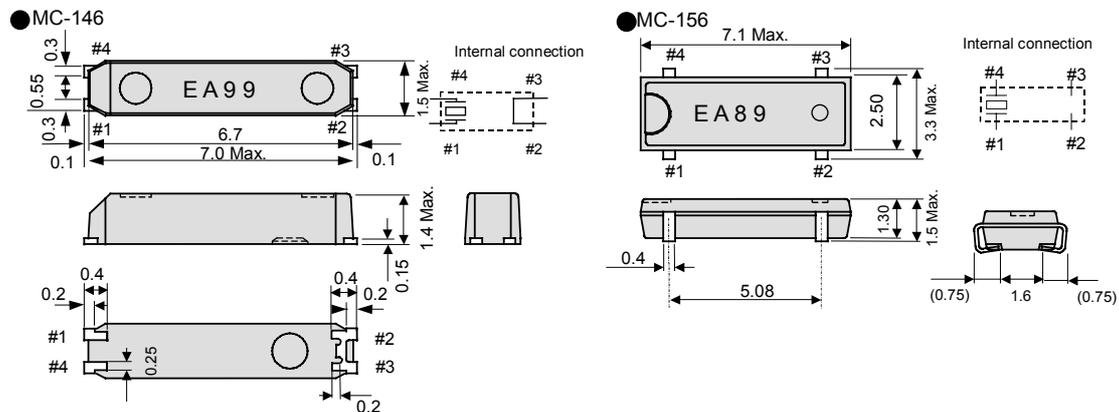
EA89

### Specifications (characteristics)

Item	Symbol	Specifications		Remarks
Nominal frequency range	f	32.768 kHz	32 kHz to 100 kHz	Please contact us for inquiries regarding available frequencies
Temperature range	Storage temperature	-55 °C to +125 °C		Stored as bare product after unpacking
	Operating temperature	-40 °C to +85 °C		
Level of drive	DL	1.0 μW Max.		Operating Drive level 0.5 μW Max.
Frequency tolerance (standard)	f_tol	± 20 × 10 <sup>-6</sup> , ± 50 × 10 <sup>-6</sup>	± 50 × 10 <sup>-6</sup> , ± 100 × 10 <sup>-6</sup>	+25 °C, DL=0.1 μW
Turnover temperature	Ti	+25 °C ± 5 °C		
Parabolic coefficient	B	-0.04 × 10 <sup>-6</sup> / °C <sup>2</sup> Max.		
Load capacitance	CL	7 pF, 12.5 pF		Please specify
Motional resistance (ESR)	R <sub>1</sub>	65 kΩ Max.	65 kΩ to 25 kΩ	
Motional capacitance	C <sub>1</sub>	1.9 fF Typ.	2.5 fF to 0.6 fF	
Shunt capacitance	C <sub>0</sub>	0.8 pF Typ.	1.2 pF to 0.5 pF	
Frequency aging	f_age	±3 × 10 <sup>-6</sup> / year Max.		+25 °C, First year

### External dimensions

(Unit:mm)

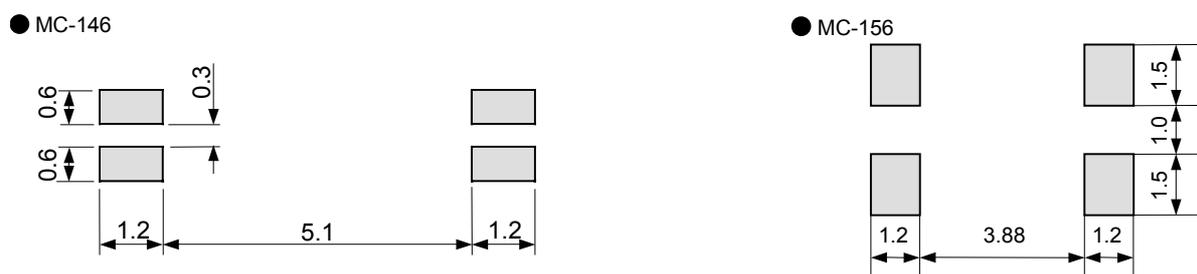


Do not connect #2 and #3 to external device.

Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

### Footprint (Recommended)

(Unit:mm)



**kHz RANGE CRYSTAL UNIT  
SMD**

**MC - 306 / 405 / 406**

- Frequency range : 32.768 kHz (20 kHz to 165 kHz)
- Thickness : 2.54 mm Max.(MC-306)  
3.60 mm Max.(MC-405 / 406)
- Overtone order : Fundamental /Overtone (307.2 kHz)
- Applications : Clock and Microcomputer
- Lead(Pb)-free : High melting temperature type solder (Pb85 %) exempted by RoHS directive.



Actual size



**Specifications (characteristics)**

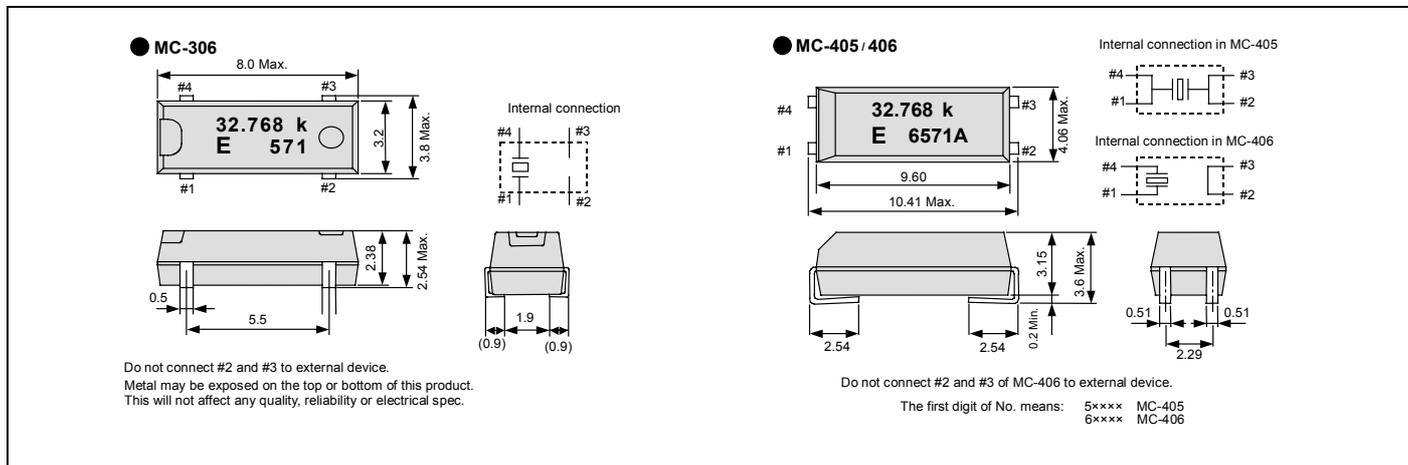
Item	Symbol	Specifications		Remarks
Nominal frequency range	f	32.768 kHz	20 kHz to 165 kHz 307.2 kHz(MC-405 / 406)	Please contact us regarding available frequencies
Temperature range	Storage temperature	-55 °C to +125 °C		Stored as bare product after unpacking
	Operating temperature	-40 °C to +85 °C		
Level of drive	DL	1.0 μW Max.		
Frequency tolerance (standard)	f <sub>tol</sub>	±20 × 10 <sup>-6</sup> , ±50 × 10 <sup>-6</sup>	±50 × 10 <sup>-6</sup> , ±100 × 10 <sup>-6</sup>	+25 °C, DL=0.1 μW
Turnover temperature	T <sub>i</sub>	+25 °C ±5 °C		
Parabolic coefficient	B	-0.04 × 10 <sup>-6</sup> / °C <sup>2</sup> Max.		
Load capacitance	CL	6 pF to ∞ (standard : 12.5 pF)		Please specify
Motional resistance (ESR)	R <sub>1</sub>	50 kΩ Max.	55 kΩ to 6 kΩ	As per below table
		1.8 fF Typ.	4.0 fF to 0.6 fF	MC-306
Motional capacitance	C <sub>1</sub>	2.0 fF Typ.		MC-405 / 406
		0.9 pF Typ.		MC-306
Shunt capacitance	C <sub>0</sub>	0.85 pF Typ.	2.0 pF to 0.6 pF	MC-405 / 406
				MC-306
Frequency aging	f <sub>age</sub>	±3 × 10 <sup>-6</sup> / year Max.	±5 × 10 <sup>-6</sup> / year Max.	+25 °C, First year

**Motional resistance (ESR)**

Frequency	20 kHz≤f< 31.2 kHz	31.2 kHz≤f< 40 kHz	40 kHz≤f< 90 kHz	90 kHz≤f< 130 kHz	130 kHz≤f<165 kHz	307.2 kHz
Motional resistance	55 kΩ Max.	35 kΩ Max.	20 kΩ Max.	12 kΩ Max.	10 kΩ Max.	6 kΩ Max.

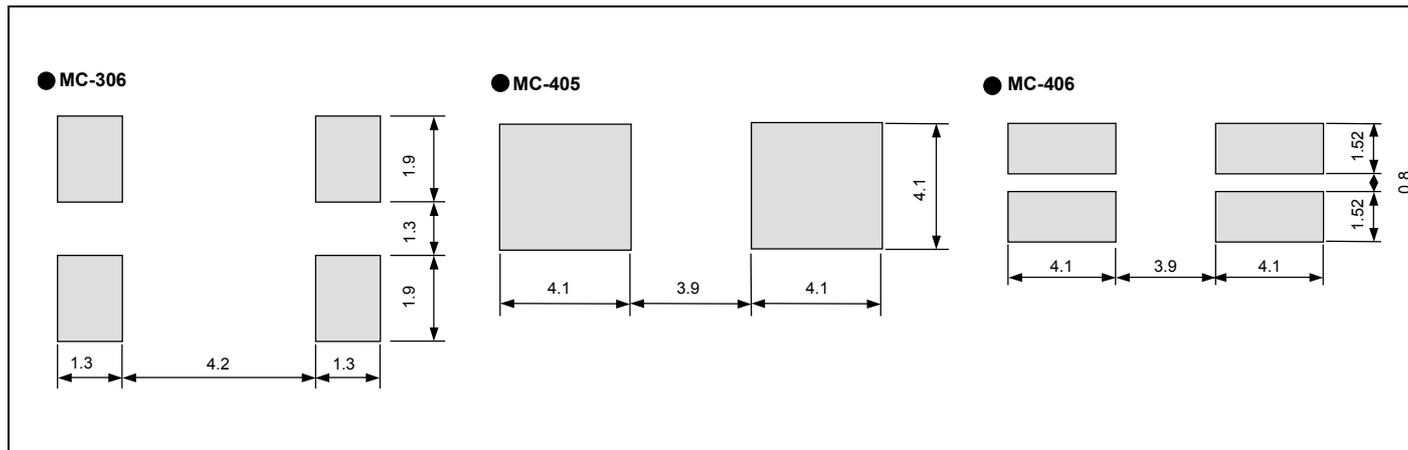
**External dimensions**

(Unit:mm)



**Footprint (Recommended)**

(Unit:mm)



## kHz RANGE CRYSTAL UNIT FOR AUTOMOTIVE APPLICATIONS

### MC - 30A

- Frequency range : 32.768 kHz (20 kHz to 165 kHz)
- Thickness : 2.54 mm Max.
- Overtone order : Fundamental
- Applications : Accessories and ECU sub clock
- Lead(Pb)-free : High melting temperature type solder (Pb85 %) exempted by RoHS directive.



Actual size



### Specifications (characteristics)

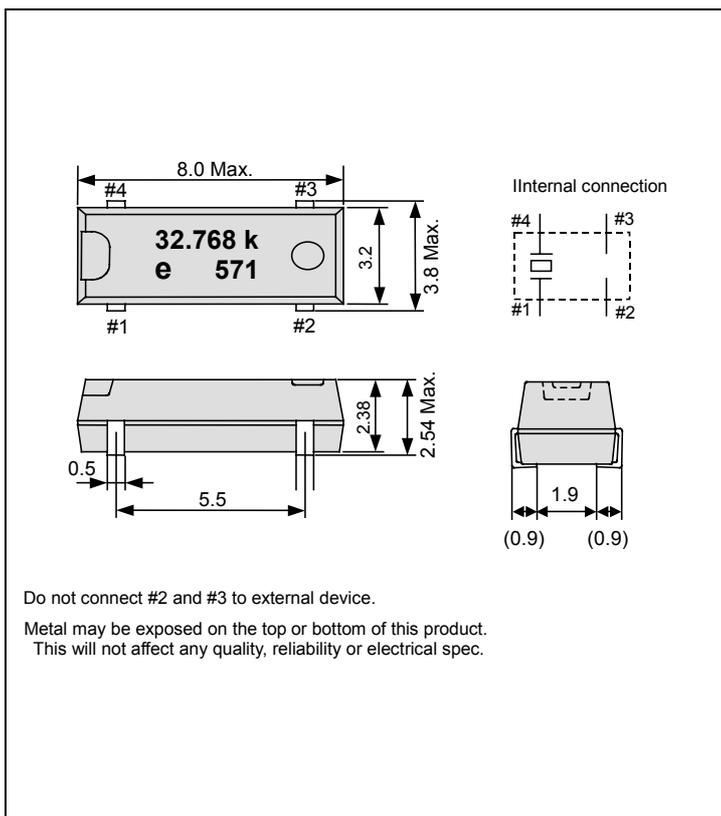
Item		Symbol	Specifications		Remarks
Nominal frequency range		f	32.768 kHz	20 kHz to 165 kHz	Please contact us regarding available frequencies
Temperature range	Storage temperature	T_stg	-55 °C to +125 °C		Stored as bare product after unpacking
	Operating temperature	T_use	-40 °C to +85 °C		
Level of drive		DL	1.0 μW Max.		
Frequency tolerance (standard)		f_tol	$\pm 20 \times 10^{-6}$ , $\pm 50 \times 10^{-6}$	$\pm 50 \times 10^{-6}$ , $\pm 100 \times 10^{-6}$	+25 °C, DL=0.1 μW
Turnover temperature		Ti	+25 °C $\pm 5$ °C		
Parabolic coefficient		B	$-0.04 \times 10^{-6} / \text{°C}^2$ Max.		
Load capacitance		CL	6 pF to $\infty$ (standard : 12.5 pF)		Please specify
Motional resistance (ESR)		R <sub>1</sub>	50 kΩ Max.	55 kΩ to 10 kΩ	As per below table
Motional capacitance		C <sub>1</sub>	1.8 fF Typ.	4.0 fF to 0.6 fF	
Shunt capacitance		C <sub>0</sub>	0.9 pF Typ.	2.0 pF to 0.6 pF	
Frequency aging		f_age	$\pm 3 \times 10^{-6} / \text{year}$ Max.	$\pm 5 \times 10^{-6} / \text{year}$ Max.	+25 °C, First year

### Motional resistance (ESR)

Frequency	20 kHz ≤ f < 31.2 kHz	31.2 kHz ≤ f < 40 kHz	40 kHz ≤ f < 90 kHz	90 kHz ≤ f < 130 kHz	130 kHz ≤ f ≤ 165 kHz
Motional resistance	55 kΩ Max.	35 kΩ Max.	20 kΩ Max.	12 kΩ Max.	10 kΩ Max.

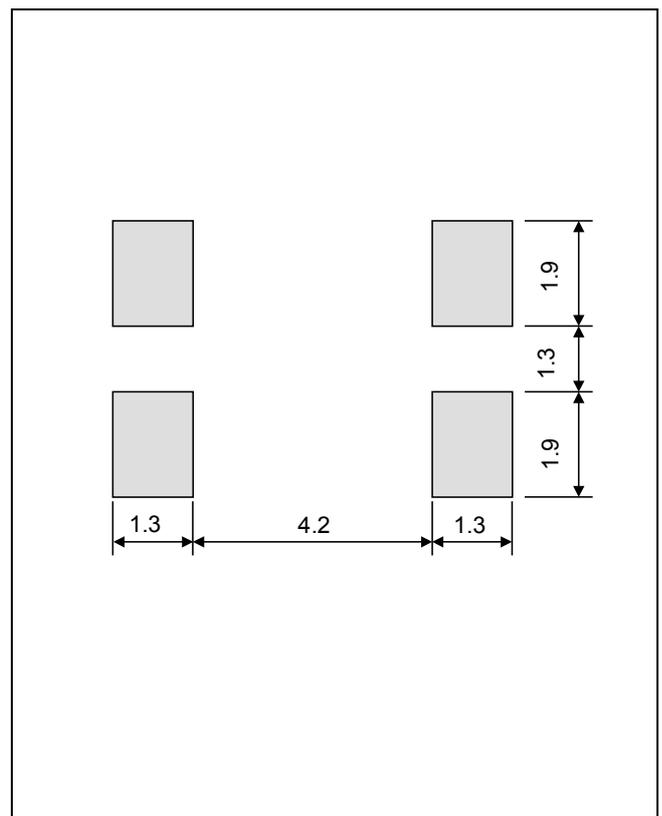
### External dimensions

(Unit:mm)



### Footprint (Recommended)

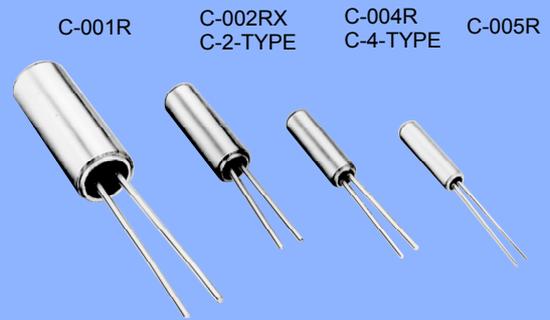
(Unit:mm)



## kHz RANGE CRYSTAL UNIT CYLINDER

### C-TYPE C-2-TYPE / C-4-TYPE

- Frequency range : 32.768 kHz (20 kHz to 307.2 kHz)
- Thickness :  $\phi 1.2$  mm to  $\phi 3.1$  mm
- Overtone order : Fundamental / Overtone (192 kHz, 307.2 kHz)
- Applications : Clock and Microcomputer
- Lead(Pb)-free : Lead free completely



Actual size

C-002RX



#### Specifications for C-TYPE (characteristics)

Item	Symbol	C-001R	C-002RX	C-004R	C-005R	Remarks
Nominal frequency range	f	32.768 kHz				
Temperature range	Storage temperature T_stg	-20 °C to +70 °C				Stored as bare product after unpacking
	Operating temperature T_use	-10 °C to +60 °C				
Level of drive	DL	1.0 $\mu$ W Max.				
Frequency tolerance (standard)	f_tol	$\pm 20 \times 10^{-6}$				+25 °C, DL=0.1 $\mu$ W
Turnover temperature	Ti	+25 °C $\pm 5$ °C				
Parabolic coefficient	B	$-0.04 \times 10^{-6} / ^\circ\text{C}^2$ Max.				
Load capacitance	CL	6 pF to $\infty$				Please specify
Motional resistance (ESR)	R <sub>1</sub>	35 k $\Omega$ Max. (18 k $\Omega$ Typ.)	50 k $\Omega$ Max. (30 k $\Omega$ Typ.)		50 k $\Omega$ Max. (37 k $\Omega$ Typ.)	
Motional capacitance	C <sub>1</sub>	2.1 fF Typ.	2.0 fF		1.9 fF Typ.	
Shunt capacitance	C <sub>0</sub>	0.9 pF Typ.	0.85 pF		0.75 pF Typ.	
Frequency aging	f_age	$\pm 3 \times 10^{-6} / \text{year}$ Max.				+25 °C, First year

#### Specifications for C-2-TYPE C-4-TYPE (characteristics)

Item	Symbol	Specifications		Remarks
		C-2-TYPE	C-4-TYPE	
Nominal frequency range	f	20 kHz to 165 kHz, 307.2 kHz	32 kHz to 120 kHz, 192 kHz	Overtone (192 kHz, 307.2 kHz)
Temperature range	Storage temperature T_stg	-20 °C to +70 °C		Stored as bare product after unpacking
	Operating temperature T_use	-10 °C to +60 °C		
Level of drive	DL	1.0 $\mu$ W Max.		
Frequency tolerance (standard)	f_tol	$\pm 20 \times 10^{-6}, \pm 50 \times 10^{-6}, \pm 100 \times 10^{-6}$ (307.2 kHz: $\pm 100 \times 10^{-6}$ )	$\pm 50 \times 10^{-6}, \pm 100 \times 10^{-6}$	+25 °C, DL=0.1 $\mu$ W
Turnover temperature	Ti	+25 °C $\pm 5$ °C		
Parabolic coefficient	B	$-0.04 \times 10^{-6} / ^\circ\text{C}^2$ Max.		
Load capacitance	CL	6 pF to $\infty$		Please specify
Motional resistance (ESR)	R <sub>1</sub>	55 k $\Omega$ to 6 k $\Omega$	55 k $\Omega$ to 10 k $\Omega$	As per below table
Motional capacitance	C <sub>1</sub>	4.0 fF to 0.6 fF		
Shunt capacitance	C <sub>0</sub>	2.0 pF to 0.6 pF		
Frequency aging	f_age	$\pm 5 \times 10^{-6} / \text{year}$ Max.		+25 °C, First year

#### Motional resistance C-2-TYPE

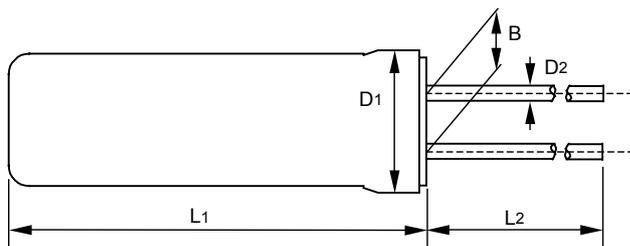
Frequency	20 kHz $\leq$ f < 31.2 kHz	31.2 kHz $\leq$ f < 40 kHz	40 kHz $\leq$ f < 90 kHz	90 kHz $\leq$ f < 130 kHz	130 kHz $\leq$ f < 165 kHz	307.2 kHz
Motional resistance	55 k $\Omega$ Max.	35 k $\Omega$ Max.	20 k $\Omega$ Max.	12 k $\Omega$ Max.	10 k $\Omega$ Max.	6 k $\Omega$ Max.

#### Motional resistance C-4-TYPE

Frequency	32 kHz $\leq$ f < 38 kHz	38 kHz $\leq$ f < 50 kHz	50 kHz $\leq$ f < 74 kHz	74 kHz $\leq$ f < 100 kHz	100 kHz $\leq$ f < 120 kHz	192 kHz
Motional resistance	50 k $\Omega$ Max.	30 k $\Omega$ Max.	25 k $\Omega$ Max.	22 k $\Omega$ Max.	15 k $\Omega$ Max.	10 k $\Omega$ Max.

#### External dimensions

(Unit:mm)



Model	L1	L2	D1	D2	B
C-001R	8.0 Max.	9.0 Min.	$\phi 3.1$ Max.	$\phi 0.3$	1.1
C-002RX C-2-TYPE	6.0 Max.	4.0 Min.	$\phi 2.0$ Max.	$\phi 0.2$	0.7
C-004R C-4-TYPE	5.0 Max.	4.0 Min.	$\phi 1.5$ Max.	$\phi 0.18$	0.5
C-005R	4.6 Max.	4.0 Min.	$\phi 1.2$ Max.	$\phi 0.15$	0.3

160 kHz to 165 kHz, 307.2 kHz: D1 =  $\phi 2.2$  Max.

## MHz RANGE CRYSTAL UNIT ULTRA MINIATURE SIZE LOW PROFILE SMD

# TSX-2520

- Nominal frequency range : 16 MHz to 54 MHz
- Thickness : 0.55mm Max.
- Overtone order : Fundamental
- Applications : Mobile phone, Bluetooth, W-LAN  
ISM band radio, Clock for MPU
- Lead(Pb)-free : Lead free completely



Actual size



### Specifications (characteristics)

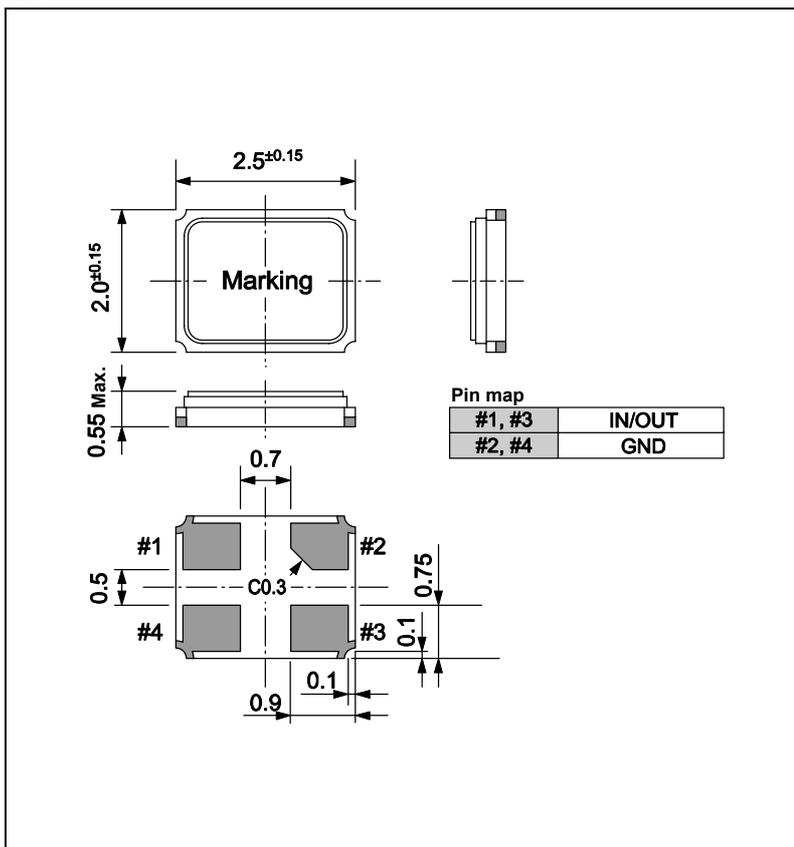
Item	Symbol	Specifications	Remarks
Nominal frequency range	f	16.000 MHz to 54.000 MHz	Fundamental
Storage temperature range	T_stg	-40 °C to +85 °C	
Operating temperature range	T_use	-20 °C to +75 °C	
Level of drive	DL	50 μW Max.	
Frequency tolerance (standard)	f_tol	$\pm 10 \times 10^{-6}$	+25 °C
Frequency versus temperature characteristics (standard)	f_tem	$\pm 10 \times 10^{-6}$	-20 °C to +75 °C
Load capacitance	CL	9 pF to ∞ (standard: 9 pF, 12 pF, 16 pF, ∞)	Please specify.
Motional resistance (ESR)	R <sub>1</sub>	As per below table	-20 °C to +75 °C
Frequency aging	f_age	$\pm 1 \times 10^{-6}$ / year Max.	+25 °C, First year

### Motional resistance (ESR)

Frequency	Motional resistance
16.0 MHz ≤ f < 21.0 MHz	100 Ω Max.
21.0 MHz ≤ f < 26.0 MHz	80 Ω Max.
26.0 MHz ≤ f ≤ 54.0 MHz	60 Ω Max.

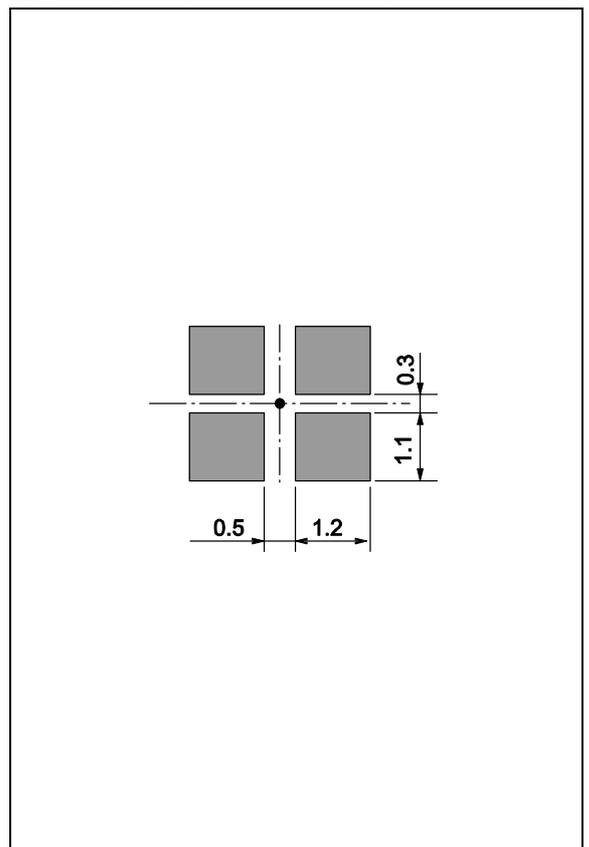
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



## MHz RANGE CRYSTAL UNIT MINIATURE SIZE LOW PROFILE SMD

### TSX-3225

- Nominal frequency range : 12 MHz to 54 MHz
- Thickness : 0.6mm Max.
- Overtone order : Fundamental
- Applications : Mobile phone, Bluetooth, W-LAN  
ISM band radio, Clock for MPU
- Lead(Pb)-free : Lead free completely



Actual size



#### Specifications (characteristics)

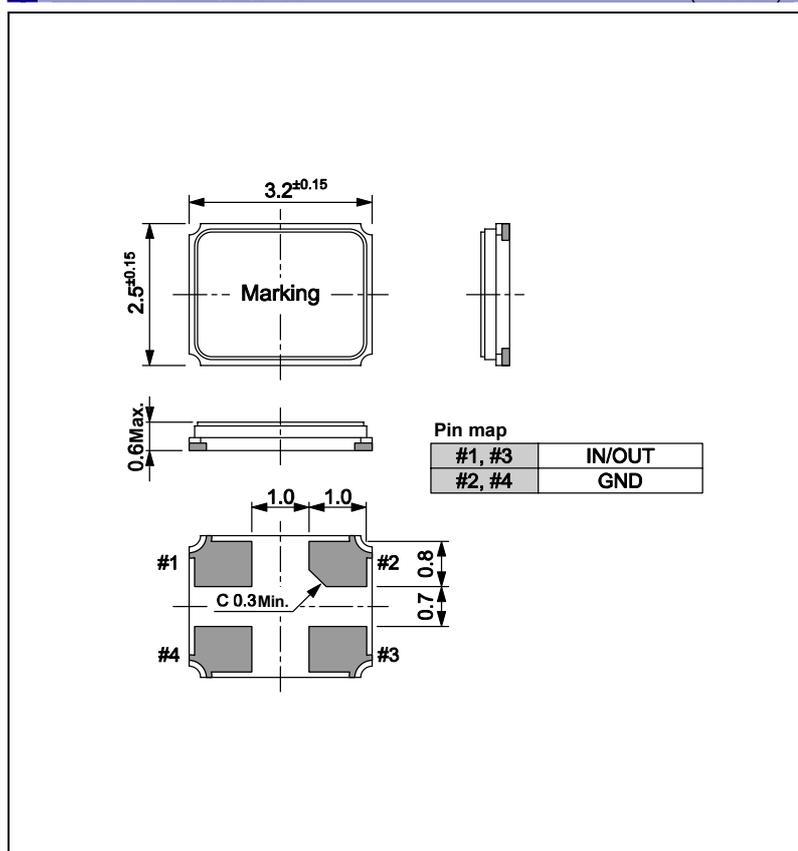
Item	Symbol	Specifications	Remarks
Nominal frequency range	f	12.000 MHz to 54.000 MHz	Fundamental
Storage temperature range	T_stg	-40 °C to +85 °C	
Operating temperature range	T_use	-20 °C to +75 °C	
Level of drive	DL	100 μW Max.	
Frequency tolerance (standard)	f_tol	$\pm 10 \times 10^{-6}$	+25 °C
Frequency versus temperature characteristics (standard)	f_tem	$\pm 10 \times 10^{-6}$	-20 °C to +75 °C
Load capacitance	CL	9 pF to ∞ (standard: 9 pF, 12 pF, 16 pF, ∞)	Please specify.
Motional resistance (ESR)	R <sub>1</sub>	As per below table	-20 °C to +75 °C
Frequency aging	f_age	$\pm 1 \times 10^{-6}$ / year Max.	+25 °C, First year

#### Motional resistance (ESR)

Frequency	Motional resistance
12.0 MHz ≤ f < 16.0 MHz	100 Ω Max.
16.0 MHz ≤ f < 21.0 MHz	60 Ω Max.
21.0 MHz ≤ f ≤ 54.0 MHz	40 Ω Max.

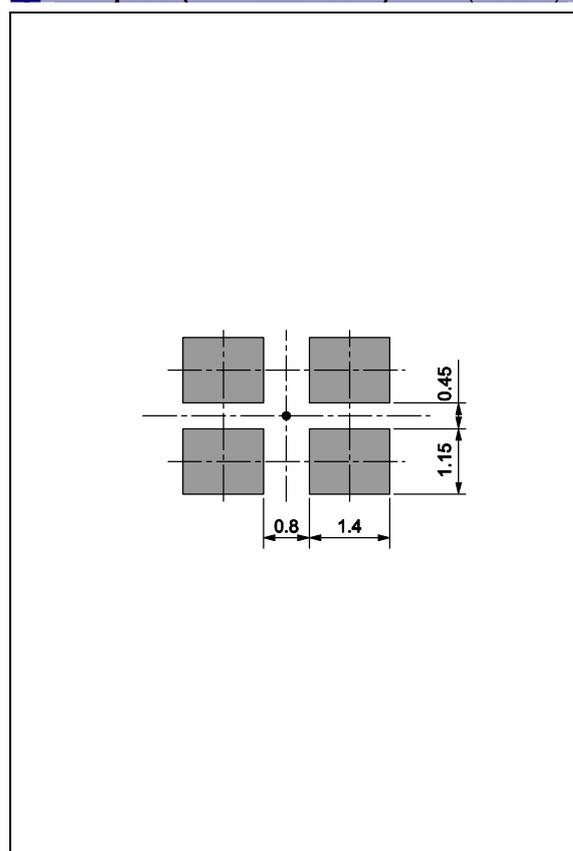
#### External dimensions

(Unit:mm)



#### Footprint (Recommended)

(Unit:mm)



**MHz RANGE CRYSTAL UNIT  
MINIATURE SIZE LOW PROFILE SMD**

**FA - 238V / 238**

- Frequency range : 12 MHz to 50 MHz
- Thickness : 0.6 mm Typ.
- Overtone order : Fundamental
- Applications : Small communications devices
  - Lead(Pb)-free : Lead free completely



Actual size

FA-238V/ 238



**Specifications (characteristics)**

Item	Symbol	Specifications		Remarks
		FA-238V	FA-238	
Nominal frequency range	f	12.000 MHz to 15.999 MHz	16.000 MHz to 50.000 MHz	Fundamental For the out of standard specifications, please contact us for inquiries.
Temperature Range	Storage temperature T <sub>stg</sub>	-40 °C to +125 °C		Stored as bare product after unpacking
	Operating temperature T <sub>use</sub>	-40 °C to +85 °C		Specified equivalent series must be satisfied
Level of drive	DL	10 μW to 100 μW		
Frequency tolerance	f <sub>tol</sub>	±50 × 10 <sup>-6</sup> (standard), (±15 × 10 <sup>-6</sup> to ±50 × 10 <sup>-6</sup> is available)		+25 °C For the out of standard specifications, please contact us for inquiries.
Frequency versus temperature characteristics	f <sub>tem</sub>	±30 × 10 <sup>-6</sup>		-20 °C to +70 °C For the out of standard specifications, please contact us for inquiries.
Load capacitance	CL	7 pF to ∞ (standard:10 pF)		For the out of standard specifications, please contact us for inquiries.
Motional resistance (ESR)	R <sub>1</sub>	As per below table		-40 °C to +85 °C, DL = 100 μW
Frequency aging	f <sub>age</sub>	±5 × 10 <sup>-6</sup> / year Max.		+25 °C, First year

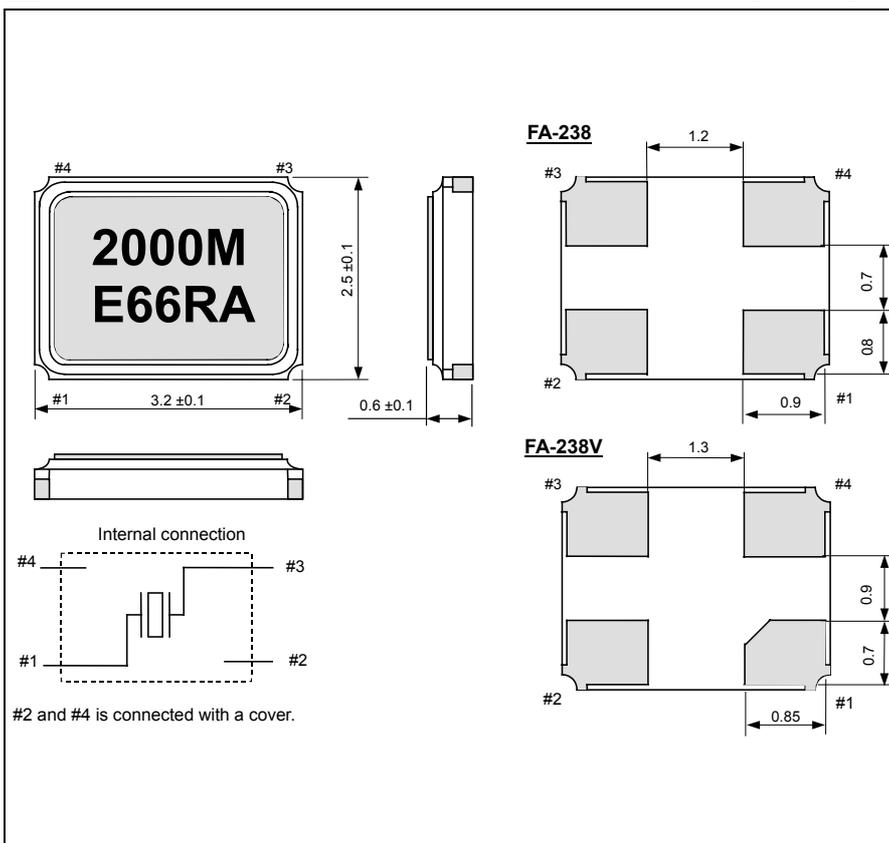
\*1 For over 40MHz, only the standard specification applies.

**Motional resistance (ESR)**

Frequency	Motional resistance
12.0 MHz ≤ f ≤ 13.0 MHz	100 Ω Max.
13.0 MHz < f < 20.0 MHz	80 Ω Max.
20.0 MHz ≤ f < 25.0 MHz	60 Ω Max.
25.0 MHz ≤ f < 30.0 MHz	50 Ω Max.
30.0 MHz ≤ f ≤ 50.0 MHz	40 Ω Max.

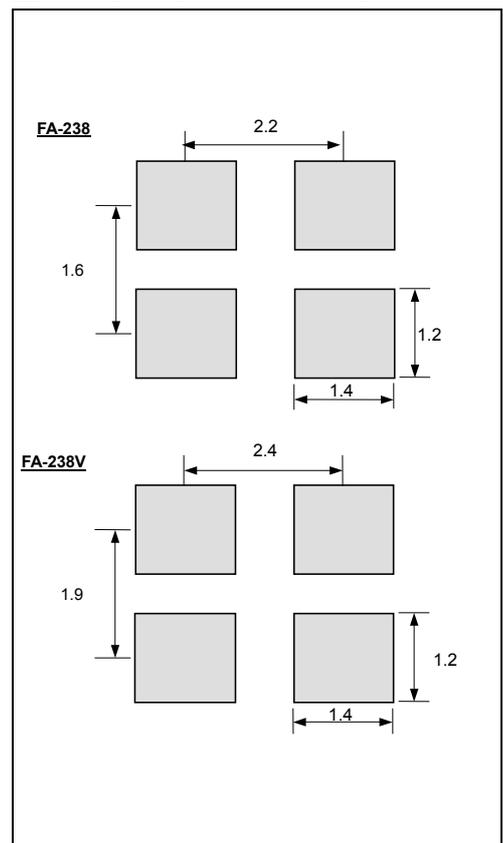
**External dimensions**

(Unit:mm)



**Footprint (Recommended)**

(Unit:mm)



## MHz RANGE CRYSTAL UNIT LOW PROFILE SMD

# TSX-4025

- Nominal frequency range : 12 MHz to 32 MHz
- Thickness : 0.7mm Max.
- Overtone order : Fundamental
- Applications : Mobile phone, Bluetooth, W-LAN  
ISM band radio, Clock for MPU
- Lead(Pb)-free : Lead free completely



Actual size

### Specifications (characteristics)

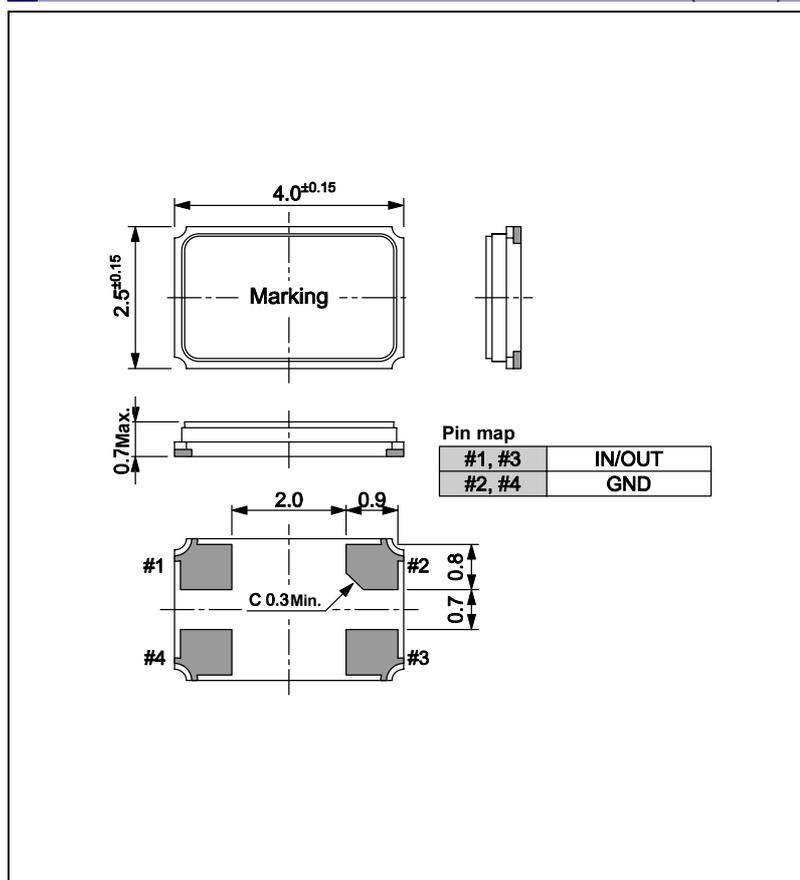
Item	Symbol	Specification	Remarks
Nominal frequency range	f	12.000 MHz to 32.000 MHz	Fundamental
Storage temperature range	T_stg	-40 °C to +85 °C	
Operating temperature range	T_use	-20 °C to +75 °C	
Level of drive	DL	100 μW Max.	
Frequency tolerance (standard)	f_tol	$\pm 10 \times 10^{-6}$	+25 °C
Frequency versus temperature characteristics (standard)	f_tem	$\pm 10 \times 10^{-6}$	-20 °C to +75 °C
Load capacitance	CL	9 pF to ∞ (standard: 9 pF, 12 pF, 16 pF, ∞)	Please specify.
Motional resistance (ESR)	R <sub>1</sub>	As per below table	-20 °C to +75 °C
Frequency aging	f_age	$\pm 1 \times 10^{-6}$ / year Max.	+25 °C, First year

### Motional resistance (ESR)

Frequency	Motional resistance
12.0 MHz ≤ f < 17.0 MHz	60 Ω Max.
17.0 MHz ≤ f ≤ 32.0 MHz	40 Ω Max.

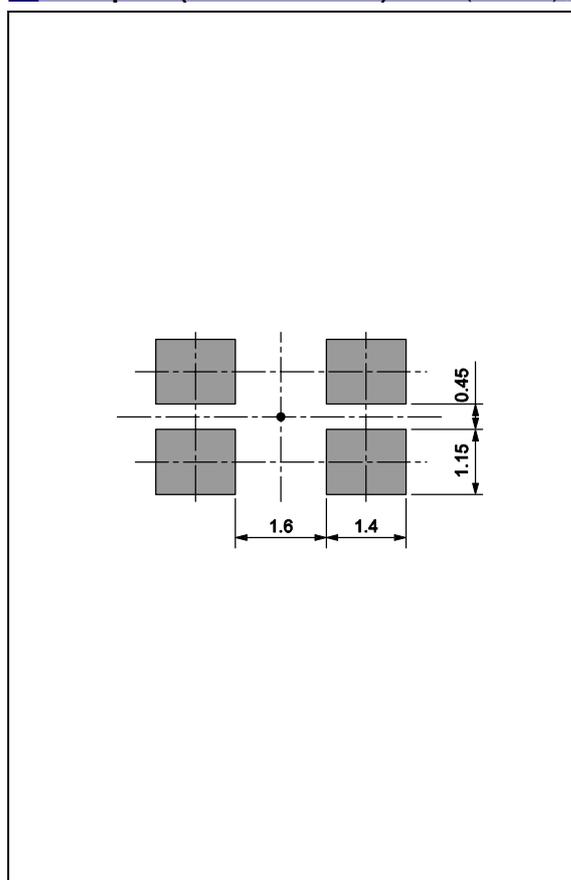
### External dimensions

(Unit:mm)



### Footprint (Recommended)

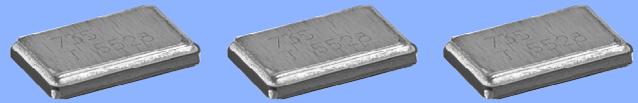
(Unit:mm)



## MHz RANGE CRYSTAL UNIT LOW PROFILE SMD

# TSX-5032

- Nominal frequency range : 10 MHz to 32 MHz
- Thickness : 0.8 mm Max.
- Overtone order : Fundamental
- Applications : Mobile phone, Bluetooth, W-LAN  
ISM band radio, Clock for MPU
- Lead(Pb)-free : Lead free completely



Actual size



### Specifications (characteristics)

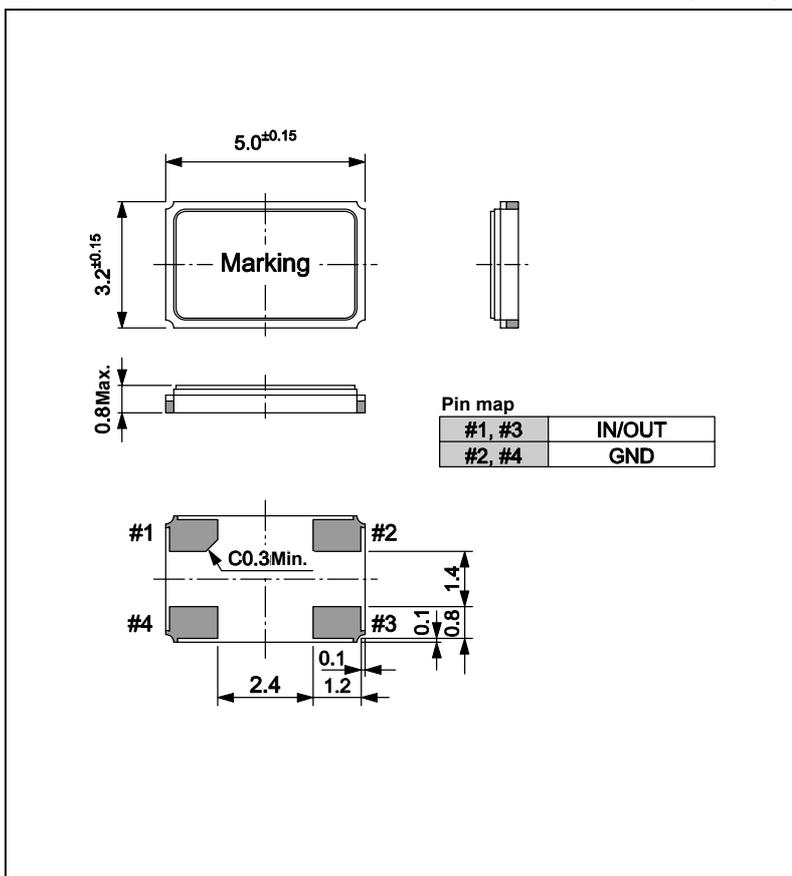
Item	Symbol	Specification	Remarks
Nominal frequency range	f	10.000 MHz to 32.000 MHz	Fundamental
Storage temperature range	T_stg	-40 °C to +85 °C	
Operating temperature range	T_use	-20 °C to +75 °C	
Level of drive	DL	100 μW Max.	
Frequency tolerance (standard)	f_tol	$\pm 10 \times 10^{-6}$	+25 °C
Frequency versus temperature characteristics (standard)	f_tem	$\pm 10 \times 10^{-6}$	-20 °C to +75 °C
Load capacitance	CL	9 pF to ∞ (standard: 9 pF, 12 pF, 16 pF, ∞)	Please specify.
Motional resistance (ESR)	R <sub>1</sub>	As per below table	-20 °C to +75 °C
Frequency aging	f_age	$\pm 1 \times 10^{-6}$ / year Max.	+25 °C, First year

### Motional resistance (ESR)

Frequency	Motional resistance
10.0 MHz ≤ f < 13.0 MHz	60 Ω Max.
13.0 MHz ≤ f ≤ 32.0 MHz	40 Ω Max.

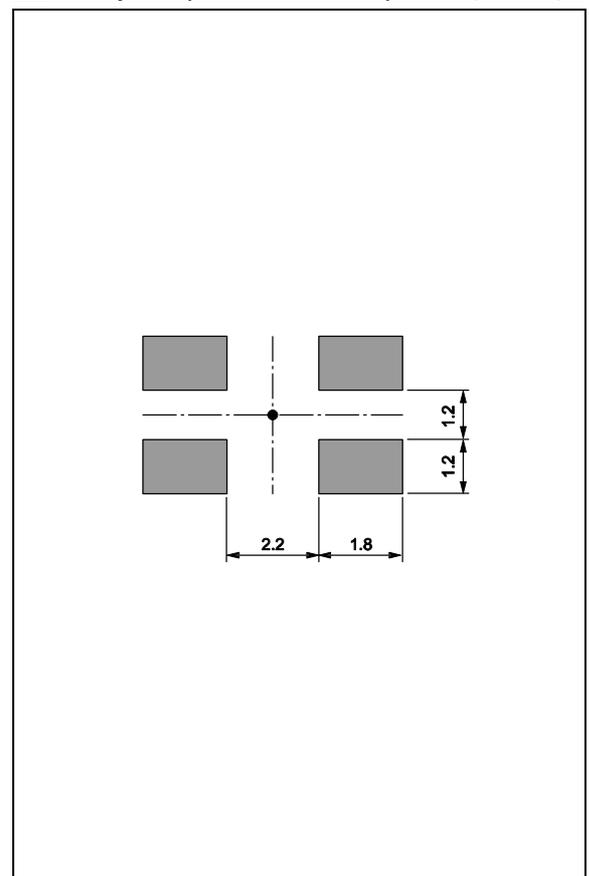
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



**MHz RANGE CRYSTAL UNIT  
LOW PROFILE SMD**

**TSX-6035**

- Nominal frequency range : 10 MHz to 32 MHz
- Thickness : 1.0mm Max.
- Overtone order : Fundamental
- Applications : Mobile phone, Bluetooth, W-LAN  
ISM band radio, Clock for MPU
- Lead(Pb)-free : Lead free completely



Actual size



**Specifications (characteristics)**

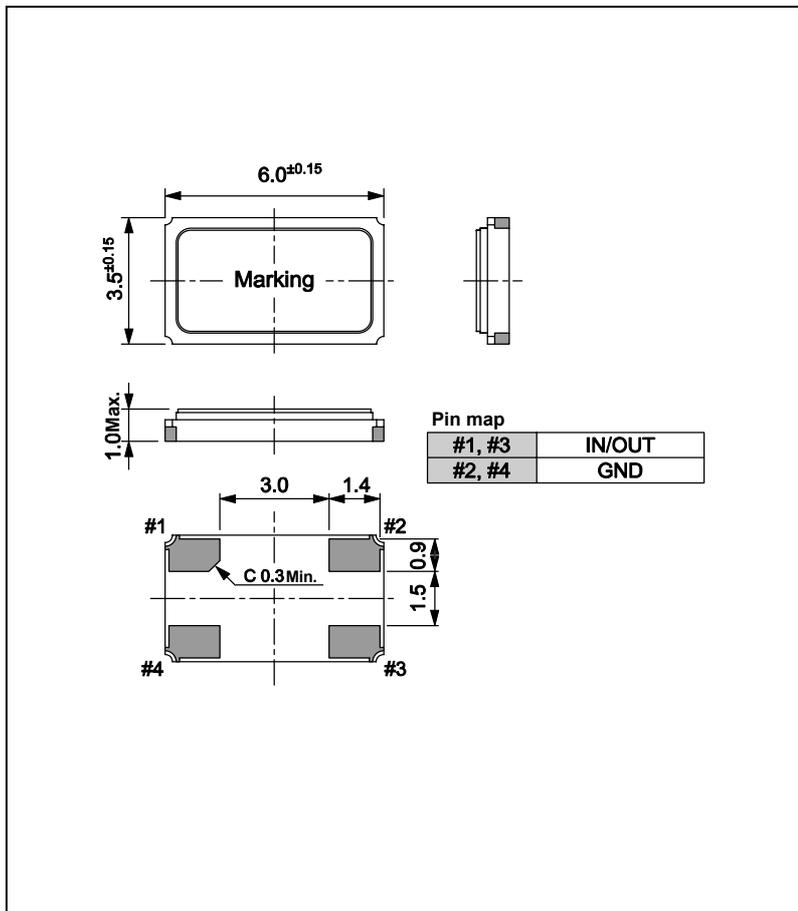
Item	Symbol	Specification	Remarks
Nominal frequency range	f	10.000 MHz to 32.000 MHz	Fundamental
Storage temperature range	T_stg	-40 °C to +85 °C	
Operating temperature range	T_use	-20 °C to +75 °C	
Level of drive	DL	100 μW Max.	
Frequency tolerance (standard)	f_tol	$\pm 10 \times 10^{-6}$	+25 °C
Frequency versus temperature characteristics (standard)	f_tem	$\pm 10 \times 10^{-6}$	-20 °C to +75 °C
Load capacitance	CL	9 pF to ∞ (standard: 9 pF, 12 pF, 16 pF, ∞)	Please specify.
Motional resistance (ESR)	R1	As per below table	-20 °C to +75 °C
Frequency aging	f_age	$\pm 1 \times 10^{-6}$ / year Max.	+25 °C, First year

**Motional resistance (ESR)**

Frequency	Motional resistance
10.0 MHz ≤ f < 12.0 MHz	60 Ω Max.
12.0 MHz ≤ f ≤ 32.0 MHz	40 Ω Max.

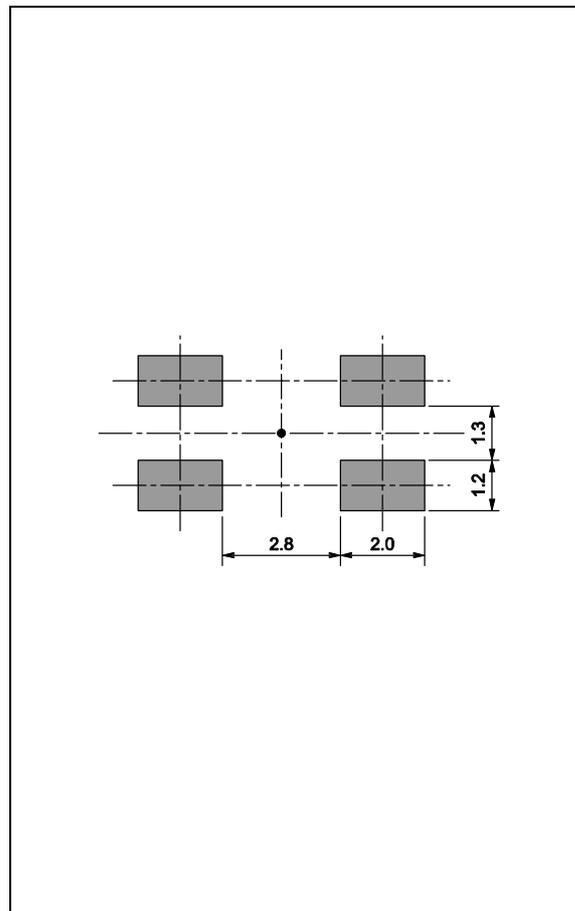
**External dimensions**

(Unit:mm)



**Footprint (Recommended)**

(Unit:mm)



## MHz RANGE CRYSTAL UNIT LOW PROFILE SMD

### FA-365

- Frequency range : 12 MHz, 14 MHz to 41 MHz
- Thickness : 1.4 mm Max.
- Overtone order : Fundamental
- Applications : For Clock of integrated circuit
- Lead(Pb)-free : Contains Pb in sealing glass exempted by RoHS directive.



Actual size

### Specifications (characteristics)

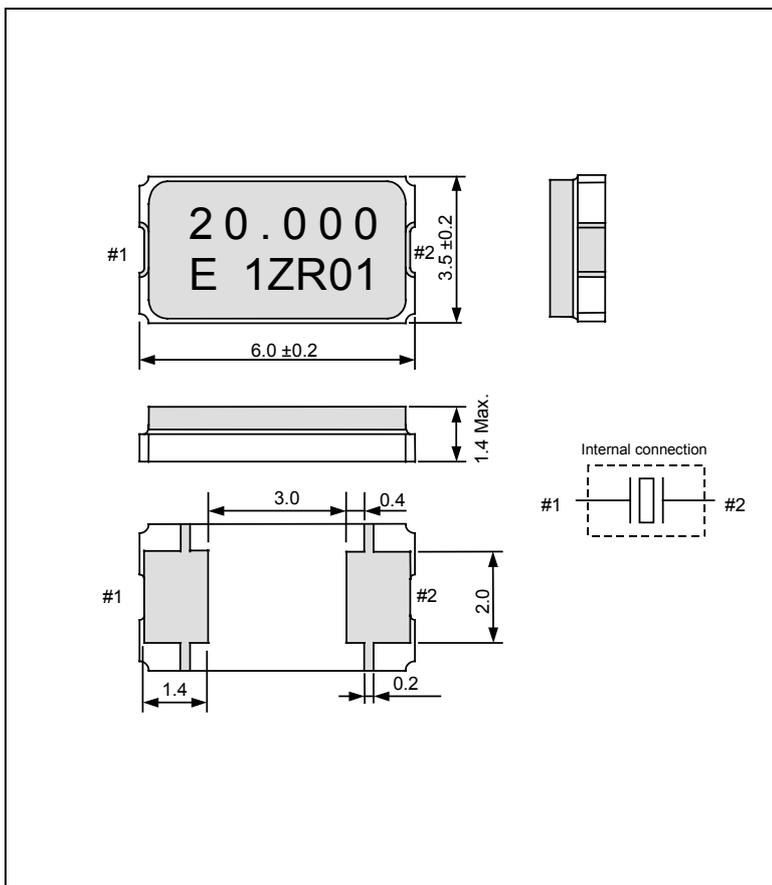
Item	Symbol	Specifications	Remarks	
Nominal frequency range	f	12.000 MHz, 14.000 MHz to 41.000 MHz	Fundamental	
Temperature range	Storage temperature	T_stg	-55 °C to +125 °C	Stored as bare product after unpacking
	Operating temperature	T_use	-20 °C to +70 °C	Please contact us on availability of -40 °C to +85 °C
Level of drive	DL	10 μW to 100 μW		
Frequency tolerance (standard)	f_tol	$\pm 50 \times 10^{-6}$ , $\pm 100 \times 10^{-6}$	+25 °C	
Frequency versus temperature characteristics (standard)		$\pm 30 \times 10^{-6}$	-20 °C to +70 °C For the out of standard specifications, please contact us for inquires	
Load capacitance	CL	10 pF to ∞	Please specify	
Motional resistance (ESR)	R1	As per below table	-20 °C to +70 °C, DL=100 μW	
Frequency aging	f_age	$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, First year	

### Motional resistance (ESR)

Frequency	Motional resistance
12.0 MHz	60 Ω Max.
14.0 MHz ≤ f ≤ 41.0 MHz	50 Ω Max.

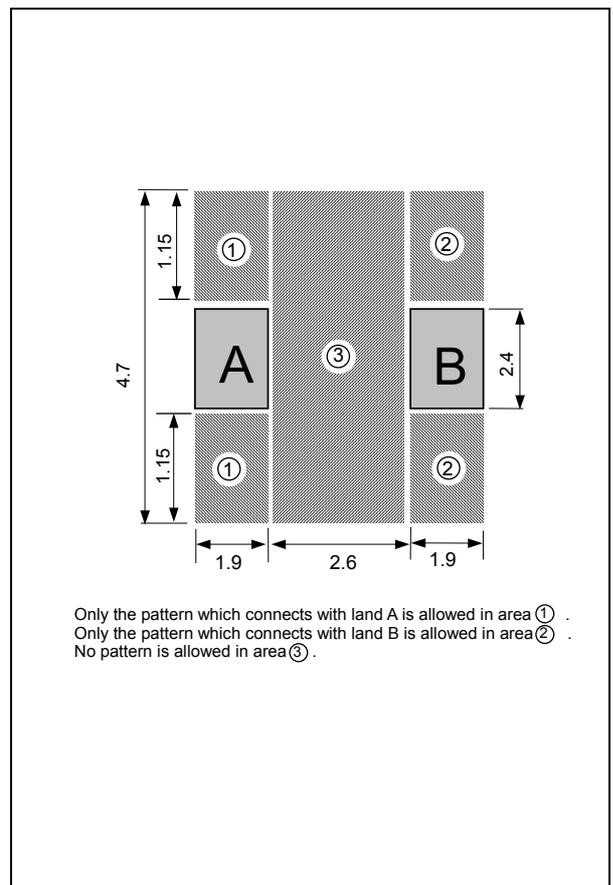
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



## MHz RANGE CRYSTAL UNIT SMD

### MA - 306

- Frequency range : 14.31818 MHz  
17.734 MHz to 41 MHz
- Thickness : 2.54 mm Max.
- Overtone order : Fundamental
- Applications : For Clock of integrated circuit
- Lead(Pb)-free : High melting temperature type solder  
(Pb85 %) exempted by RoHS directive.



Actual size

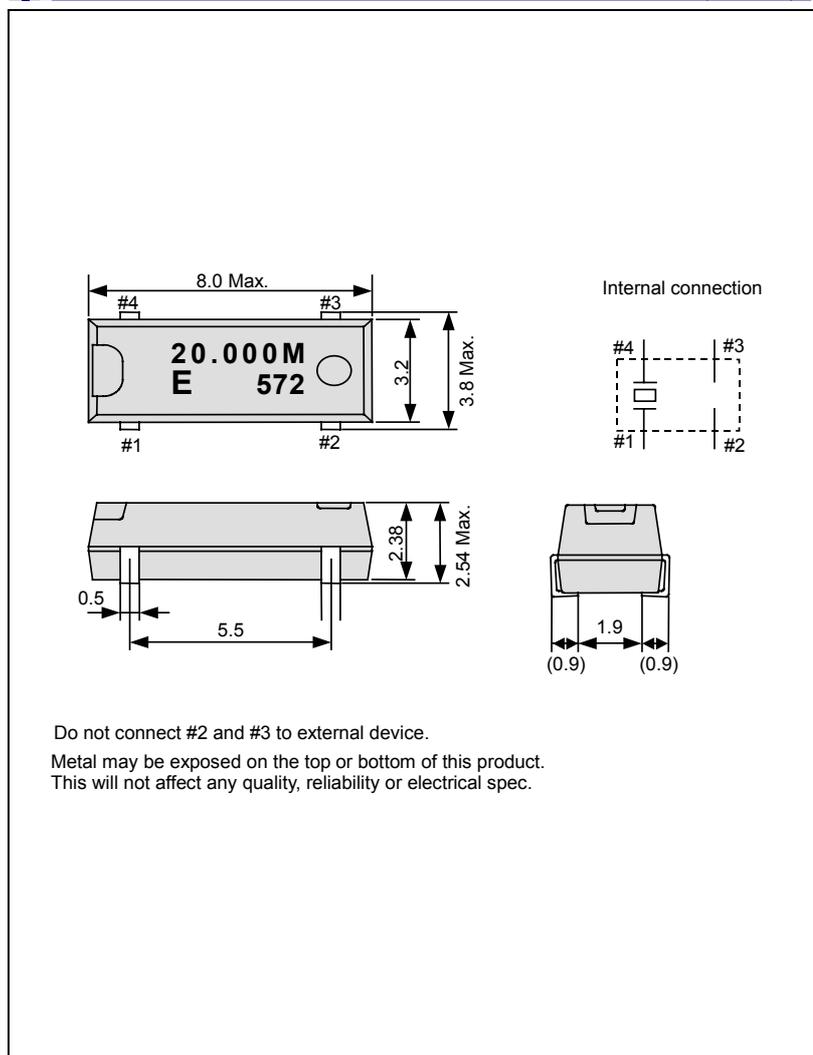


### Specifications (characteristics)

Item	Symbol	Specifications	Remarks	
Nominal frequency range	f	14.31818 MHz, 17.734 MHz to 41.000 MHz	Fundamental	
Temperature range	Storage temperature	T_stg	-55 °C to +100 °C	Stored as bare product after unpacking
	Operating temperature	T_use	-20 °C to +70 °C	
Level of drive	DL	10 μW to 100 μW		
Frequency tolerance (standard)	f_tol	±50 × 10 <sup>-6</sup>	+25 °C	
Frequency versus temperature characteristics (standard)	f_tem	±30 × 10 <sup>-6</sup>	-20 °C to +70 °C	
Load capacitance	CL	10 pF to ∞	Please specify	
Motional resistance (ESR)	R <sub>1</sub>	60 Ω Max.	-20 °C to +70 °C, DL=100 μW	
Frequency aging	f_age	±5 × 10 <sup>-6</sup> / year Max.	+25 °C, First year	

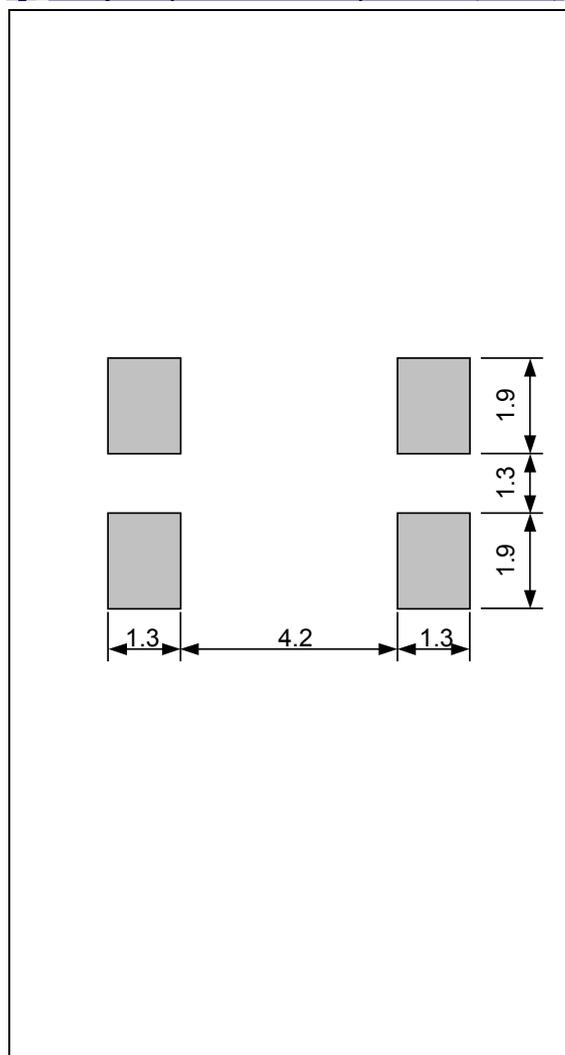
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



## MHz RANGE CRYSTAL UNIT SMD

# MA - 406 / 505 / 506

- Frequency range : 4 MHz to 64 MHz
- Thickness : 3.7 mm Max.(MA-406)  
4.6 mm Max.(MA-505 / 506)
- Overtone order : Fundamental  
3rd overtone(30 MHz to 64 MHz)
- Applications : For Clock of integrated circuit
- Lead(Pb)-free : High melting temperature type solder  
(Pb85 %) exempted by RoHS directive.



Actual size

MA-406



MA-505 / 506



### Specifications (characteristics)

Item	Symbol	Specifications	Remarks	
Nominal frequency range	f	4.000 MHz to 29.999 MHz	Fundamental *1	
		30.000 MHz to 64.000 MHz	3rd overtone *2	
Temperature range	Storage temperature	T_stg	-55 °C to +125 °C	Stored as bare product after unpacking
	Operating temperature	T_use	-20 °C to +70 °C	Please contact us on availability of -40 °C to +85 °C
Level of drive	DL	10 μW to 100 μW		
Frequency tolerance (standard)	f_tol	$\pm 50 \times 10^{-6}$	+25 °C	
Frequency versus temperature characteristics (standard)	f_tem	Under 5.5 MHz : $\pm 50 \times 10^{-6}$	-20 °C to +70 °C	
		Over 5.5 MHz : $\pm 30 \times 10^{-6}$	For the out of standard specifications, please contact us for inquiries	
Load capacitance	CL	Fundamental: 10 pF to $\infty$		
		Overtone: 5 pF to $\infty$	Please specify	
Motional resistance (ESR)	R <sub>1</sub>	As per below table	-20 °C to +70 °C, DL=100 μW	
Shunt capacitance	C <sub>0</sub>	5 pF Max.		
Frequency aging	f_age	$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, First year	

\*1 4.0 MHz  $\leq$  f < 5.5 MHz : See "Available frequencies from 4.0 MHz to less than 5.5 MHz". 8.0 MHz < f < 8.2 MHz: Unavailable.

\*2 26.000 MHz  $\leq$  f < 30.000 MHz : please contact us for inquiries for 3rd overtone mode.

### Available frequency from 4.0 MHz to less than 5.5 MHz (MHz)

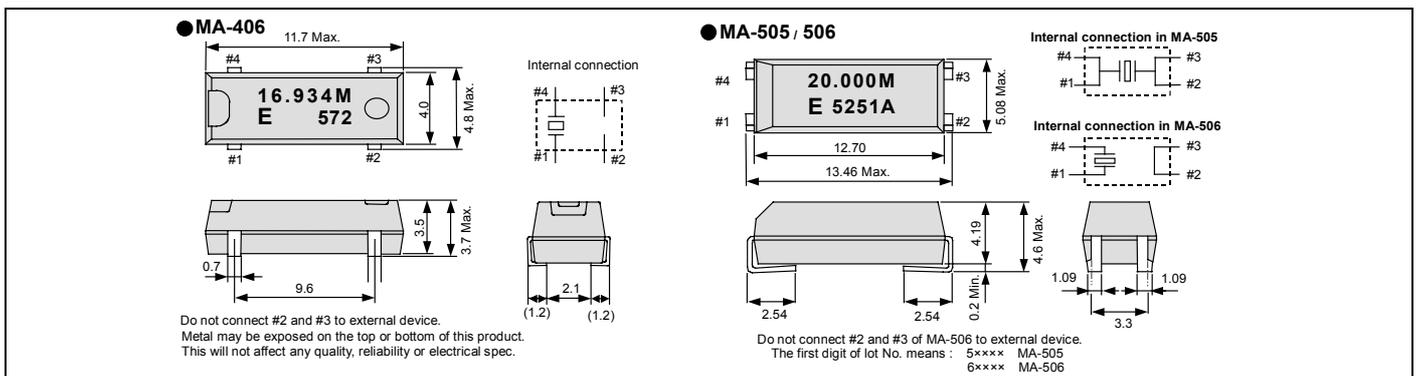
4.000	4.032	4.096	4.190	4.194304	4.433619	4.500	4.800	4.9152
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### Motional resistance (ESR)

Frequency (MHz)	4.0 $\leq$ f < 5.5	5.5 $\leq$ f < 6.0	6.0 $\leq$ f < 10.0	10.0 $\leq$ f < 12.0	12.0 $\leq$ f < 16.0	16.0 $\leq$ f < 30.0	30.0 $\leq$ f < 36.0	36.0 < f $\leq$ 64.0
Motional resistance	150 Ω Max.	100 Ω Max.	80 Ω Max.	60 Ω Max.	50 Ω Max.	40 Ω Max.	100 Ω Max.	80 Ω Max.
Overtone order			Fundamental					3rd overtone

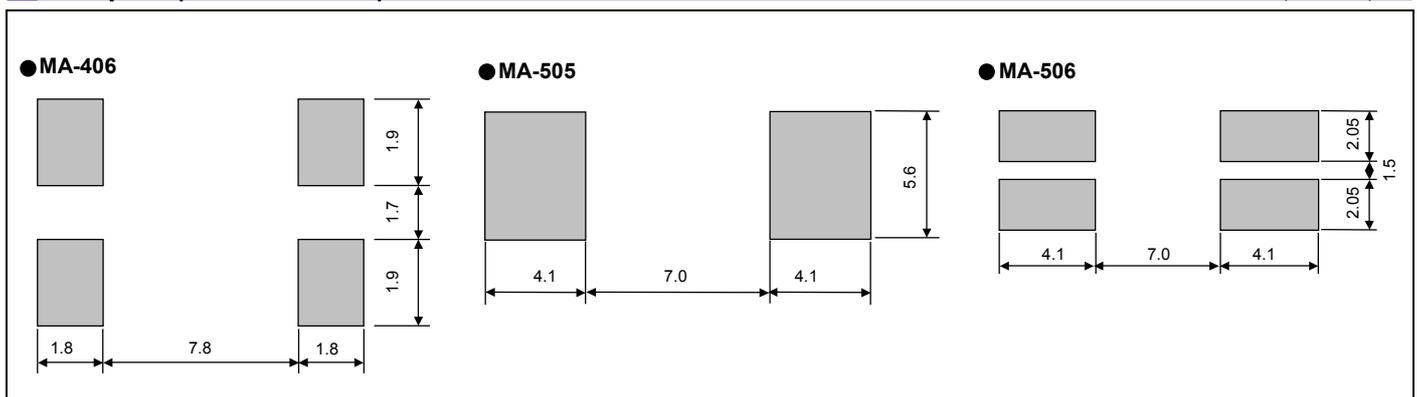
### External dimensions

(Unit:mm)



### Footprint (Recommended)

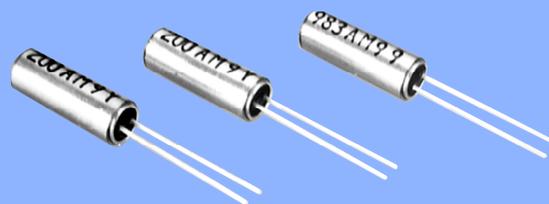
(Unit:mm)



## MHz RANGE CRYSTAL UNIT CYLINDER

# CA-301

- Frequency range : 4 MHz to 64 MHz
- Thickness :  $\phi 3.1$  mm Max.
- Overtone order : Fundamental  
3rd overtone (30 MHz to 64 MHz)
- Applications : For Clock of integrated circuit
- Lead(Pb)-free : Lead free completely



Actual size



### Specifications (characteristics)

Item	Symbol	Specification	Remarks	
Nominal frequency range	f	4.000 MHz to 29.999 MHz	Fundamental *1	
		30.000 MHz to 64.000 MHz	3rd overtone *2	
Temperature range	Storage temperature	T_stg	-40 °C to +85 °C	Stored as bare product after unpacking
	Operating temperature	T_use	-20 °C to +70 °C	The operating temperature range is -10 °C to +60 °C for 5.5 MHz and below
Level of drive	DL	10 $\mu$ W to 100 $\mu$ W		
Frequency tolerance (standard)	f_tol	$\pm 30 \times 10^{-6}$ (Under 5.5 MHz: $\pm 50 \times 10^{-6}$ , $\pm 100 \times 10^{-6}$ )	+25 °C	
Frequency versus temperature characteristics (standard)	f_tem	Under 5.5 MHz: $\pm 50 \times 10^{-6}$	-10 °C to +60 °C	
		Over 5.5 MHz: $\pm 30 \times 10^{-6}$	-20 °C to +70 °C	
Load capacitance	CL	Fundamental: 10 pF to $\infty$ .	Please specify	
		Overtone: 5 pF to $\infty$		
Motional resistance (ESR)	R <sub>1</sub>	As per below table	-20 °C to +70 °C, DL=100 $\mu$ W	
Frequency aging	f_age	$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, First year	

\*1 4.0 MHz  $\leq$  f < 5.5 MHz : See "Available frequencies from 4.0 MHz to less than 5.5 MHz". 8.0 MHz < f < 8.2 MHz: Unavailable.

\*2 26.000 MHz  $\leq$  f < 30.000 MHz : please contact us for inquiries for 3rd overtone mode.

### Available frequency from 4.0 MHz to less than 5.5 MHz (MHz)

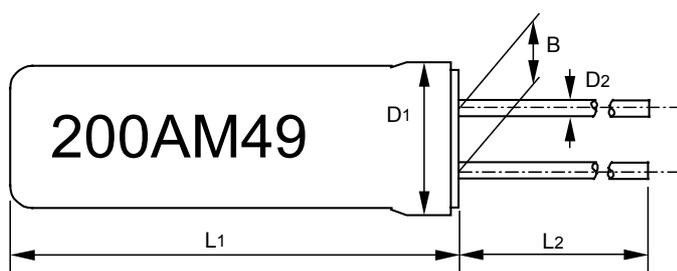
4.000	4.032	4.096	4.190	4.194304	4.433619	4.500	4.800	4.9152
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### Motional resistance (ESR)

Frequency (MHz)	4.0 $\leq$ f < 5.5	5.5 $\leq$ f < 6.0	6.0 $\leq$ f < 10.0	10.0 $\leq$ f < 12.0	12.0 $\leq$ f < 16.0	16.0 $\leq$ f < 30.0	30.0 $\leq$ f $\leq$ 36.0	36.0 < f $\leq$ 64.0
Motional resistance	150 $\Omega$ Max.	100 $\Omega$ Max.	80 $\Omega$ Max.	60 $\Omega$ Max.	50 $\Omega$ Max.	40 $\Omega$ Max.	100 $\Omega$ Max.	80 $\Omega$ Max.
Overtone order	Fundamental						3rd overtone	

### External dimensions

(Unit:mm)



Model	L1	L2	D1	D2	B
Under 5.5 MHz	9.3 Max.	9.5 Min.	$\phi$ 3.1 Max.	$\phi$ 0.3	1.1
Over 5.5 MHz	8.9 Max.	9.5 Min.	$\phi$ 3.1 Max.	$\phi$ 0.3	1.1

## SAW RESONATOR HIGH-STABILITY

# NS-32R / FS-335 / 555

- Frequency range : 230 MHz to 870 MHz
- Thickness : 0.98 mm Typ.(NS-32R/FS-335)  
1.50 mm Typ.(FS-555)
- Overtone order : Fundamental
- Applications : Small wireless equipment
- Lead(Pb)-free : Lead free completely



Actual size

NS-32R



FS-335



FS-555



### Specifications (characteristics)

Item	Symbol	Specifications			Remark
		NS-32R	FS-335	FS-555	
Nominal frequency range	f	312 MHz to 870 MHz	300 MHz to 870 MHz	230 MHz to 500 MHz	Please contact us regarding available frequencies
Temperature range	Storage temperature	-40 °C to +85 °C			Stored as bare product after unpacking
	Operating temperature	-40 °C to +85 °C			
Level of drive	DL	1 mW Typ.	2 mW Typ.		FS-335 : f > 500 MHz 1 mW Typ.
Frequency tolerance (standard)	f <sub>tol</sub>	As per below table			+25 °C
Turnover temperature	T <sub>i</sub>	+25 °C ± 20 °C	+25 °C ± 15 °C		Please specify
Parabolic coefficient	B	-(1.6 ± 0.4) × 10 <sup>-8</sup> / °C <sup>2</sup>			-(3.4 ± 0.8) × 10 <sup>-8</sup> / °C <sup>2</sup>
Harmonic ratio	Rs/R <sub>1</sub>	2 Min.			
Motional resistance (ESR)	R <sub>1</sub>	As per below table			
Frequency aging	f <sub>age</sub>	±10 × 10 <sup>-6</sup> / year Max.			+25 °C
Shock resistance	S.R.	±10 × 10 <sup>6</sup> Max.			Nine drops on a concrete from 1500 mm

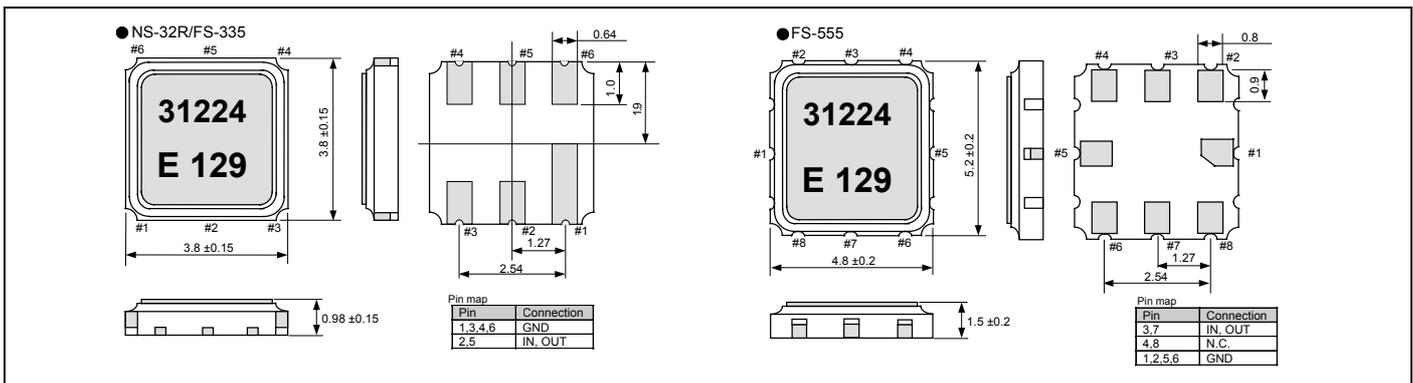
### Frequency tolerance / Motional resistance

Model	Item	312 MHz to 500 MHz	500 MHz to 870 MHz
NS-32R	Frequency tolerance (standard)	±50 × 10 <sup>-6</sup> , ±100 × 10 <sup>-6</sup>	±100 × 10 <sup>-6</sup>
	Motional resistance (ESR)	30 Ω Max.	

Model	Item	230 MHz to 250 MHz	250 MHz to 300 MHz	300 MHz to 500 MHz	500 MHz to 870 MHz
FS-335	Frequency tolerance (standard)	—	—	±25 × 10 <sup>-6</sup> , ±50 × 10 <sup>-6</sup> , ±100 × 10 <sup>-6</sup>	±100 × 10 <sup>-6</sup>
	Motional resistance (ESR)	—	—	25 Ω Max.	40 Ω Max.
FS-555	Frequency tolerance (standard)	±25 × 10 <sup>-6</sup> , ±50 × 10 <sup>-6</sup> , ±100 × 10 <sup>-6</sup>			—
	Motional resistance (ESR)	40 Ω Max.	25 Ω Max.		—

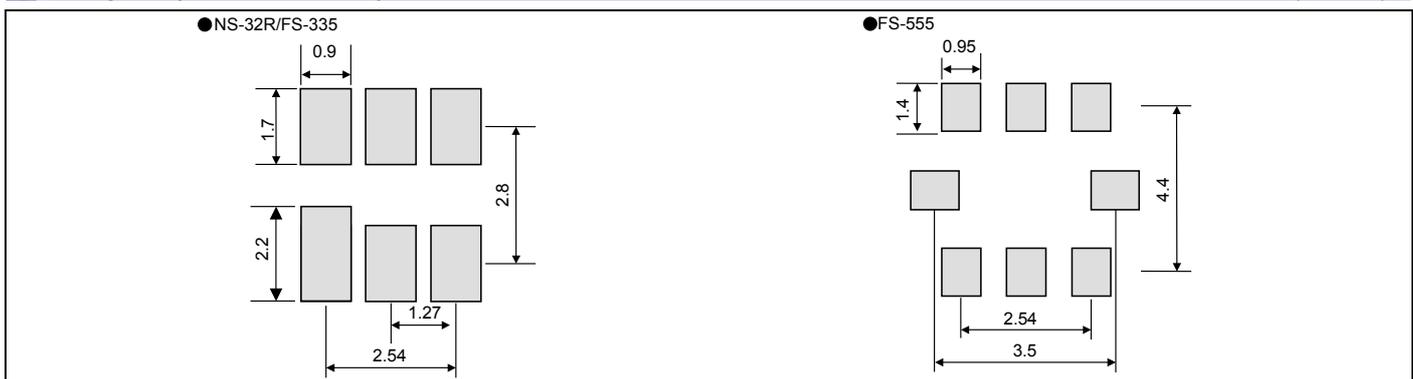
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



**SAW RESONATOR  
FOR TPMS**

**FS - 585**

- Frequency range : 300 MHz to 500 MHz
- Thickness : 1.5 mm Typ.
- Overtone order : Fundamental
- Applications : TPMS, Small wireless equipment
- Lead(Pb)-free : Lead free completely



Actual size

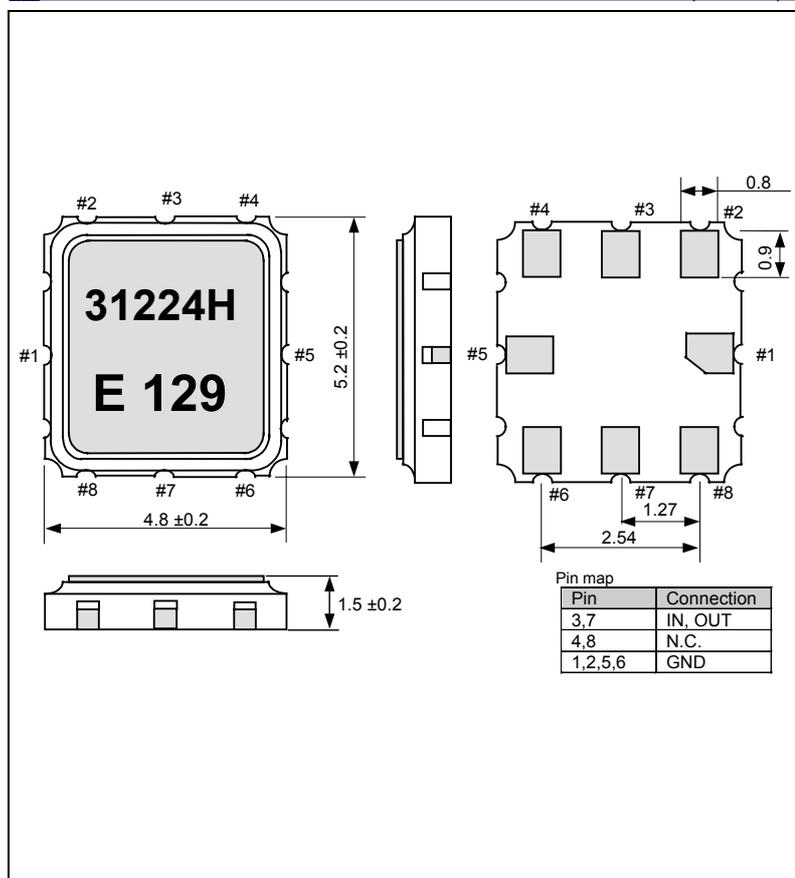


**Specifications (characteristics)**

Item	Symbol	Specifications	Remarks	
Nominal frequency range	f	300 MHz to 500 MHz	Please contact us for inquiries regarding available frequencies.	
Temperature range	Storage temperature	T <sub>stg</sub>	-40 °C to +125 °C	Stored as bare product after unpacking
	Operating temperature	T <sub>use</sub>	-40 °C to +120 °C	
Level of drive	DL	2 mW Typ.		
Frequency tolerance (standard)	f <sub>tol</sub>	±50 × 10 <sup>-6</sup> , ±100 × 10 <sup>-6</sup>	+25 °C	
Turnover temperature	T <sub>i</sub>	+40 °C ±10 °C	Please contact us for inquiries about Peak temperature	
Parabolic coefficient	B	-(3.4 ±0.8) × 10 <sup>-8</sup> / °C <sup>2</sup>		
Harmonic ratio	Rs/ R <sub>1</sub>	2 Min.		
Motional resistance(ESR)	R <sub>1</sub>	18 Ω Max.		
Frequency aging	f <sub>age</sub>	±10 × 10 <sup>-6</sup> / year Max.	+25 °C	
Shock resistance	S.R.	±10 × 10 <sup>-6</sup> Max.	Nine drops on a concrete from 1500 mm	

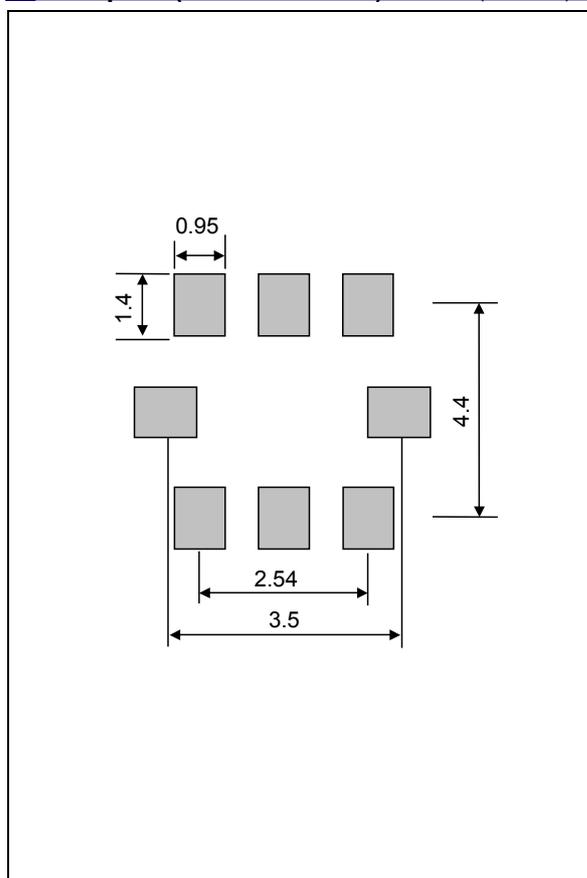
**External dimensions**

(Unit:mm)



**Footprint (Recommended)**

(Unit:mm)



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# Crystal Oscillator

Category	Model	Actual size (mm) Typ.	Frequency range	Page.
SPXO	SG-3030JC SG-3040JC SG-3032JC	 10.5×5.8×2.7 t (Max.)	32.768 kHz	30
	SG-3030JF	 7.1×5.1×1.5 t (Max.)	32.768 kHz	
	SG-3030LC SG-3040LC	 3.6×2.8×1.1 t	32.768 kHz	
	SG-310 Series	 3.2×2.5×1.05 t	2 MHz to 48 MHz	31
	SG-350 Series	 3.3×2.6×1.15 t	1 MHz to 48 MHz	32
	SG-550 Series	 5.0×3.2×1.2 t(Max.)	1 MHz to 48 MHz	
	TCO-7106X1A TCO-7107X1A	 5.0×3.2×1.0 t	1.5 MHz to 75 MHz	33
	TCO-708x Series	 7.0×5.0×1.6 t	1.5 MHz to 135 MHz	34
	TCO-7116H1A (3.3 V LV-PECL)	 7.0×5.0×1.6 t	50 MHz to 213 MHz	35
	SG-710 Series	 7.3×4.8×1.3 t	1.8 MHz to 125 MHz	36
	SG-645 Series	 7.1×5.1×1.5 t (Max.)	32.001 MHz to 135 MHz	37
	SG-636 Series	 10.5×5.8×2.7 t (Max.)	2.21675 MHz to 135 MHz	38~39
	SG-615 Series	 14.0×9.8×4.7 t (Max.)	1.025 MHz to 135 MHz	40~41
	SG-531 Series	 DIP half size	1.025 MHz to 135 MHz	
	SG-51 Series	 DIP full size	1.025 MHz to 66.667 MHz	
	TCO-711A7	 DIP full size	1.5 MHz to 100 MHz	42
Programmable	SG-8002CE Series	 3.2×2.5×1.05 t	1 MHz to 125 MHz	43
	SG-8002LA Series	 3.3×2.6×1.15 t	1 MHz to 125 MHz	44
	SG-8002LB Series	 5.0×3.2×1.2 t (Max.)	1 MHz to 125 MHz	
	SG-8002JF Series	 7.1×5.1×1.5 t (Max.)	1 MHz to 125 MHz	45
	SG-8002CA Series	 7.0×5.0×1.4 t	1 MHz to 125 MHz	
	SG-8002JC Series	 10.5×5.8×2.7 t (Max.)	1 MHz to 125 MHz	46
	SG-8002JA Series	 14.0×9.8×4.7 t (Max.)	1 MHz to 125 MHz	
	SG-8002DC Series	 DIP half size	1 MHz to 125 MHz	
	SG-8002DB Series	 DIP full size	1 MHz to 125 MHz	47
	<b>SG-8002 Series Specification List</b>			
<b>SG-8002 Series Characteristics Chart</b>				49
<b>SG-8002 Series Programming Tool</b>				50



# Crystal Oscillator

Category	Model	Actual size (mm) Typ.	Frequency range	Page.	
Spread Spectrum	SG-9001LB Series		5.0×3.2×1.2 t(Max.)	10 MHz to 135 MHz	51
	SG-9001CA Series		7.0×5.0×1.4 t	10 MHz to 166 MHz	
	SG-9001JC Series		10.5×5.8×2.7 t (Max.)	10 MHz to 166 MHz	
Low jitter SAW	XG-1000CA Series		7.0×5.0×1.2 t	50 MHz to 170 MHz	52
	XG-1000CB Series		5.0×3.2×1.1 t	50 MHz to 170 MHz	
	EG-2021CA Series (2.5 V CMOS)		7.0×5.0×1.2 t	62.5 MHz to 170 MHz	53
	EG-2001CA Series (3.3 V CMOS)		7.0×5.0×1.2 t	106.25 MHz to 170 MHz	
	EG-2002CA (3.3 V LV-TTL)		7.0×5.0×1.2 t	62.5 MHz to 170 MHz	54
	EG-2121CA Series (2.5 V Differential LV-PECL/LV-DS)		7.0×5.0×1.2 t	53.125 MHz to 500 MHz LV-PECL 53.125 MHz to 700 MHz LV-DS	55
	EG-2102CA Series (3.3 V Differential LV-PECL/LV-DS)		7.0×5.0×1.2 t	100 MHz to 700 MHz LV-PECL 53.125 MHz to 700 MHz LV-DS	
	EG-2101CA (3.3 V Differential LV-PECL)		7.0×5.0×1.2 t	62.5 MHz to 400 MHz	56
High-stability	HG-2150CA Series		7.0×5.0×1.5 t(Max.)	1 MHz to 80 MHz	57
	HG-8002JA Series		14.0×9.8×4.7 t (Max.)	1 MHz to 125 MHz	58
	TCO-391B TCO-391C Series		9.6×11.4×5.0 t (Max.)	8 MHz to 78 MHz	59
	TCO-393F		20.0×12.5×6.0 t (Max.)	100 MHz to 500 MHz	60
	TCO-3110 Series		13.9×9.8×4.7 t (Max.)	60 MHz to 800 MHz	61
	TCO-3131		13.9×9.8×4.7 t (Max.)	60 MHz to 700 MHz	62
	TCO-743A7/HC7		DIP full size	1.5 MHz to 60 MHz	63
	Multi-output	MG-5020JE		7.0×6.0×1.5 t (Max.)	32.768 kHz and 48.00512 MHz
MG-5100SA Series			10.1×7.4×3.2 t	76.9 kHz to 100 MHz	65

**CRYSTAL OSCILLATOR**  
32.768 kHz

**SG-3030LC / JF / JC**  
**SG-3040LC / JC**  
**SG-3032JC**

- No adjustment required with 32.768 kHz crystal unit built-in.
- Use of CMOS IC enables reduction of current consumption.
- VIO controls swing amplitude (SG-3030 / SG-3040).
- Lead(Pb)-free : High melting temperature type solder (Pb85 %) exempted by RoHS directive;SG-xxxxJC/JF  
Contains Pb in sealing glass exempted by RoHS directive.; SG-xxxxLC

SG-3030LC  
SG-3040LC

SG-3030JF

SG-3030JC  
SG-3040JC  
SG-3032JC



Actual size

LC Type.

JF Type.

JC Type.

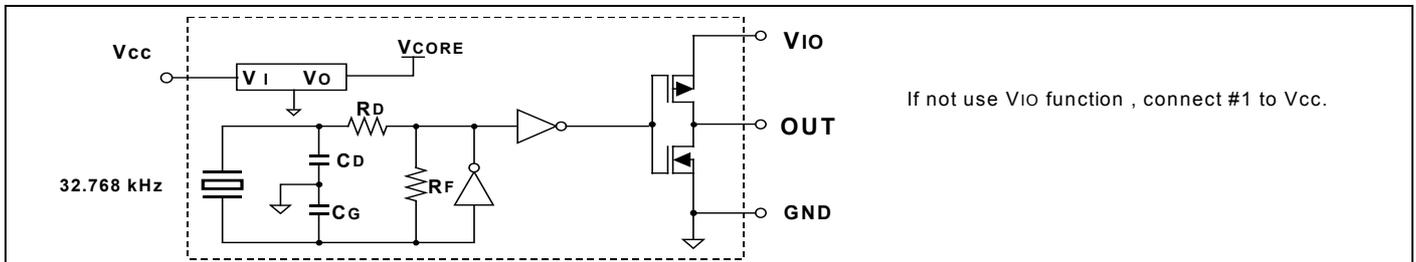


**Specifications (characteristics)**

Item	Symbol	Specifications			Remarks
		SG-3030LC / JF / JC	SG-3040LC / JC	SG-3032JC	
Output frequency range	f <sub>o</sub>	32.768 kHz			
Supply voltage	V <sub>cc</sub>	1.5 V to 5.5 V	0.9 V to 3.6 V	1.8 V to 3.6 V	
Interface power supply voltage	V <sub>io</sub>	1.5 V to 5.5 V	0.9 V to 3.6 V	—	
Temperature range	T <sub>stg</sub>	-55 °C to +125 °C			Stored as bare product after unpacking
Storage temperature	T <sub>use</sub>	-40 °C to +85 °C			
Operating temperature		-20 °C to +70 °C			
Frequency tolerance	F <sub>tol(osc)</sub>	5 ±23 × 10 <sup>-6</sup>			+25 °C, V <sub>cc</sub> =3.3 V (SG-3040: V <sub>cc</sub> =1.2 V)
Frequency temperature coefficient	F <sub>o-Tc</sub>	+10 × 10 <sup>-6</sup> / -120 × 10 <sup>-6</sup>			-20 °C to +70 °C (+25 °C is reference)
Frequency / voltage coefficient	F <sub>o-Vcc</sub>	±2 × 10 <sup>-6</sup> / V Max.	±5 × 10 <sup>-6</sup> / V Max.	±2 × 10 <sup>-6</sup> / V Max.	+25 °C
Current consumption	I <sub>cc</sub>	2 μA Max.	3.1 μA Max.	5 μA Max.	3.3 V, No load condition
Symmetry	SYM	45 % to 55 %			1/2 V <sub>cc</sub> (V <sub>io</sub> )level (SG-3040: V <sub>io</sub> =1.2 V to 3.6 V)
High output voltage	V <sub>OH</sub>	V <sub>io</sub> -0.4 V Min.			I <sub>OH</sub> =-0.4 mA (SG-3040: V <sub>io</sub> =1.2 V to 3.6 V)
Low output voltage	V <sub>OL</sub>	0.4 V Max.			I <sub>OL</sub> = 0.4 mA (SG-3040: V <sub>io</sub> =1.2 V to 3.6 V)
Output load condition (CMOS)	L <sub>CMOS</sub>	15 pF Max.			CMOS load
Output rise and fall time	t <sub>r</sub> / t <sub>f</sub>	200 ns Max.	100 ns Max.		CMOS load:20 % V <sub>cc</sub> (V <sub>io</sub> ) to 80 % V <sub>cc</sub> (V <sub>io</sub> )level (SG-3040: V <sub>io</sub> =1.2 V to 3.6 V)
Oscillation start up time	t <sub>osc</sub>	1 s Max.	3 s Max.		Time at minimum Supply voltage to be 0 s
Frequency aging	F <sub>aging</sub>	±5 × 10 <sup>-6</sup> / year Max.			+25 °C (SG-3030: V <sub>cc</sub> = 2.0 V to 5.5 V) +25 °C, V <sub>cc</sub> = 3.3 V, First year

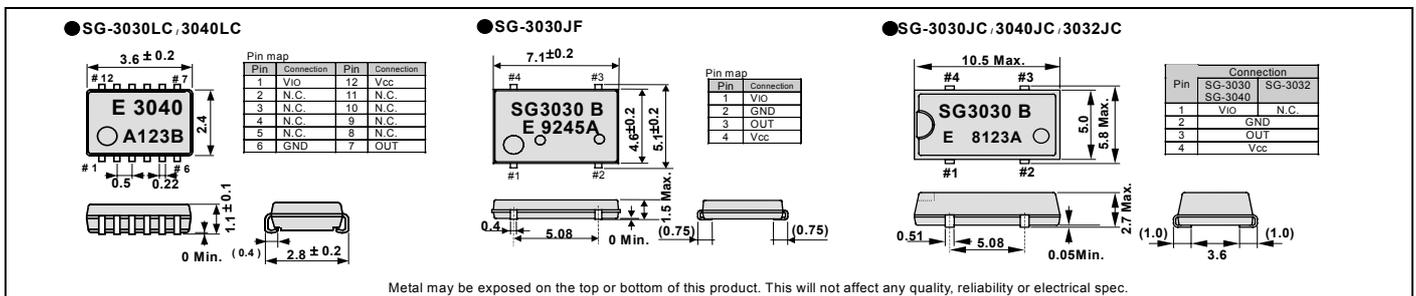
Unless otherwise stated, characteristics (specifications) shown in the above table are based on the rated operating temperature and voltage condition.

**Block diagram (SG-3030LC / JC / JF, SG3040JC / LC)**



**External dimension**

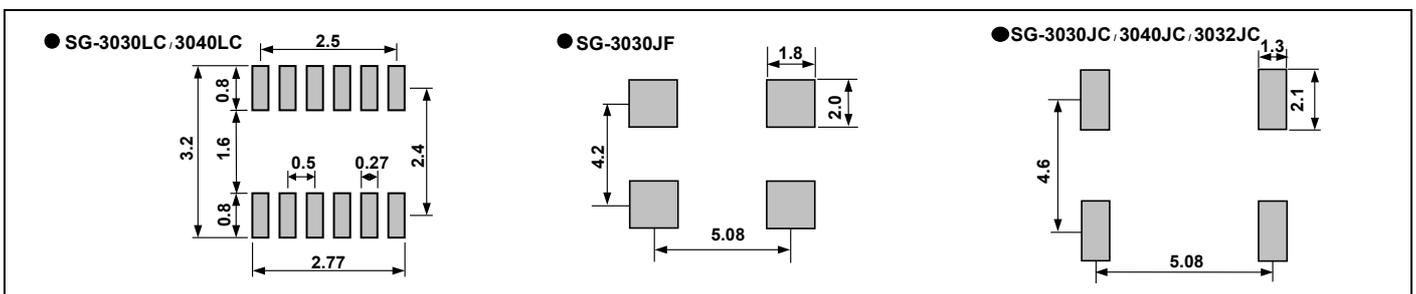
(Unit:mm)



Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

**Footprint (Recommended)**

(Unit:mm)



## CRYSTAL OSCILLATOR SPXO

### SG-310 series

- Frequency range : 2 MHz to 48 MHz
- Supply voltage : 1.8 V Typ. / 2.5 V Typ. / 3.3 V Typ.
- Current consumption : SEF1.8 V No load condition 48 MHz  
1.5 mA Typ.
- Function : Standby( $\overline{ST}$ )
- Thickness : 1.05 mm Typ.
- Lead(Pb)-free : Lead free completely



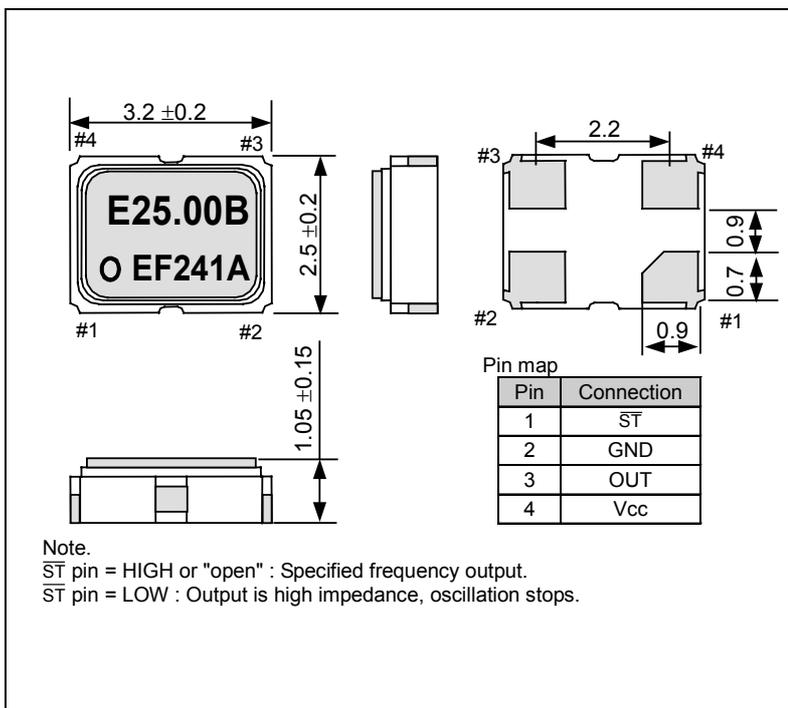
Actual size

### Specifications (characteristics)

Item	Symbol	Specifications			Remarks
		SEF	SDF	SCF	
Output frequency range	$f_0$	2.000 MHz to 48.000 MHz			
Supply voltage	$V_{CC}$	1.8 V Typ. 1.6 V to 2.2 V	2.5 V Typ. 2.2 V to 3.0 V	3.3 V Typ. 2.7 V to 3.6 V	
Temperature range	Storage temperature	$T_{stg}$			Stored as bare product after unpacking
	Operating temperature	$T_{use}$			
Frequency tolerance	$F_{tol}(osc)$	B: $\pm 50 \times 10^{-6}$ , C: $\pm 100 \times 10^{-6}$			-20 °C to +70 °C
		M: $\pm 100 \times 10^{-6}$			-40 °C to +85 °C
Current consumption	$I_{CC}$	1.5 mA Max.	1.5 mA Max.	1.5 mA Max.	No load condition, 2 MHz $\leq f_0 \leq$ 4 MHz
		1.5 mA Max.	1.5 mA Max.	2.0 mA Max.	No load condition, 4 MHz $\leq f_0 \leq$ 8 MHz
		1.5 mA Max.	2.0 mA Max.	2.5 mA Max.	No load condition, 8 MHz $\leq f_0 \leq$ 16 MHz
		2.0 mA Max.	2.0 mA Max.	2.5 mA Max.	No load condition, 16 MHz $\leq f_0 \leq$ 25 MHz
		2.0 mA Max.	2.5 mA Max.	3.5 mA Max.	No load condition, 25 MHz $\leq f_0 \leq$ 33 MHz
		3.0 mA Max.	3.5 mA Max.	4.5 mA Max.	No load condition, 33 MHz $\leq f_0 \leq$ 48 MHz
Stand-by current	$I_{std}$	0.7 $\mu$ A Max. (0.2 $\mu$ A Typ.)	1.5 $\mu$ A Max. (0.5 $\mu$ A Typ.)	2.0 $\mu$ A Max. (1.0 $\mu$ A Typ.)	$\overline{ST}$ = GND
Symmetry	SYM	45 % to 55 %	45 % to 55 %		2 MHz $\leq f_0 \leq$ 16 MHz
			40 % to 60 %		16 MHz $\leq f_0 \leq$ 33 MHz
			40 % to 60 %		33 MHz $\leq f_0 \leq$ 40 MHz
				40 MHz $\leq f_0 \leq$ 48 MHz	50 % $V_{CC}$ level $L_{CMOS} \leq 15$ pF
High output voltage	$V_{OH}$	90 % $V_{CC}$ Min.			$I_{OH} = -3$ mA
Low output voltage	$V_{OL}$	10 % $V_{CC}$ Max.			$I_{OL} = 3$ mA
Output load condition (CMOS)	$L_{CMOS}$	15 pF Max.			
Output enable / disable input voltage	$V_{IH}$	80 % $V_{CC}$ Min.			$\overline{ST}$ terminal
	$V_{IL}$	20 % $V_{CC}$ Max.			
Output rise and fall time	$tr/ tf$	4 ns Max.			20 % $V_{CC}$ to 80 % $V_{CC}$ level, $L_{CMOS} = 15$ pF
Oscillation start up time	$t_{osc}$	10 ms Max.			$t = 0$ at 90 % $V_{CC}$
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max.			+25 °C, First year, $V_{CC} = 1.8$ V, 2.5 V, 3.3 V

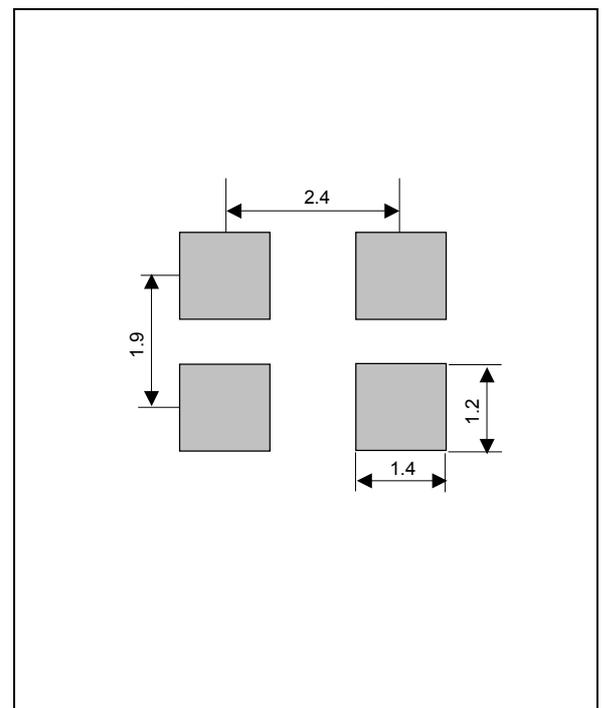
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



**CRYSTAL OSCILLATOR  
SPXO**

**SG - 350 / 550 series**

- Frequency range : 1 MHz to 48 MHz
- Supply voltage : 1.8 V Typ. / 2.5 V Typ. / 3.3 V Typ.
- Current consumption : SEF 1.8 V No load condition 48 MHz  
1.5 mA Typ.
- Function : Standby( $\overline{ST}$ )
- Thickness : 1.2 mm Max.
- Lead(Pb)-free : Lead free completely



Actual size

SG-350

SG-550

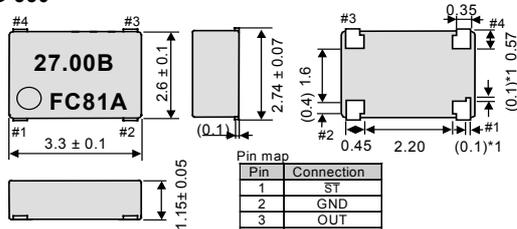
**Specifications (characteristics)**

Item	Symbol	Specifications				Remarks	
		SEF	SDF	SCF	SCG		
Output frequency range	$f_o$	2 MHz to 48 MHz			1 MHz to 48 MHz		
Supply voltage	$V_{CC}$	1.8 V Typ. 1.6 V to 2.2 V	2.5 V Typ. 2.2 V to 3.0 V	3.3 V Typ. 2.7 V to 3.6 V			
Temperature range	Storage temperature	-40 °C to +125 °C				Stored as bare product after unpacking	
	Operating temperature	-40 °C to +85 °C					
Frequency tolerance	$F_{tol(osc)}$	B: $\pm 50 \times 10^{-6}$ , C: $\pm 100 \times 10^{-6}$			—	-20 °C to +70 °C	
		M: $\pm 100 \times 10^{-6}$			—	-40 °C to +85 °C	
		L: $\pm 50 \times 10^{-6}$			S: $\pm 25 \times 10^{-6}$	-20 °C to +70 °C	$V_{CC} \pm 5\%$
Current consumption	$I_{CC}$	1.5 mA Max.	1.5 mA Max.	1.5 mA Max.	—	No load condition, 2 MHz $\leq f_o \leq$ 4 MHz	
		1.5 mA Max.	1.5 mA Max.	2.0 mA Max.	—	No load condition, 4 MHz $\leq f_o \leq$ 8 MHz	
		1.5 mA Max.	2.0 mA Max.	2.5 mA Max.	—	No load condition, 8 MHz $\leq f_o \leq$ 16 MHz	
		2.0 mA Max.	2.0 mA Max.	2.5 mA Max.	—	No load condition, 16 MHz $\leq f_o \leq$ 33 MHz	
		2.0 mA Max.	2.5 mA Max.	3.5 mA Max.	—	No load condition, 25 MHz $\leq f_o \leq$ 33 MHz	
		3.0 mA Max.	3.5 mA Max.	4.5 mA Max.	—	No load condition, 33 MHz $\leq f_o \leq$ 48 MHz	
Stand-by current	$I_{std}$	0.7 $\mu$ A Max. 45 % to 55 %	1.5 $\mu$ A Max.	2.0 $\mu$ A Max.	12 mA Max.	No load condition, Max. frequency output. $\overline{ST} = GND$	
Symmetry	SYM	45 % to 55 %			45 % to 55 %	1 MHz $\leq f_o \leq$ 16 MHz	50 % $V_{CC}$ level $L_{CMOS} \leq 15$ pF
		40 % to 60 %				16 MHz $\leq f_o \leq$ 33 MHz	
High output voltage	$V_{OH}$	90 % $V_{CC}$ Min.			$V_{CC} - 0.4$ V Min.	$I_{OH} = -3$ mA(SEF, SDF, SCF), -8 mA(SCG)	
Low output voltage	$V_{OL}$	10 % $V_{CC}$ Max.			0.4 V Max.	$I_{OL} = 3$ mA(SEF, SDF, SCF), 8 mA(SCG)	
Output load condition(CMOS)	$L_{CMOS}$	15 pF Max.					
Output enable / disable input voltage	$V_{IH}$	80 % $V_{CC}$ Min.			70 % $V_{CC}$ Min.	$\overline{ST}$ terminal	
	$V_{IL}$	20 % $V_{CC}$ Max.					
Output rise and fall time	$t_r / t_f$	4 ns Max.				20 % $V_{CC}$ to 80 % $V_{CC}$ level, $L_{CMOS} = 15$ pF	
Oscillation start up time	$t_{osc}$	SG-350:2 ms Max. / SG-550:10 ms Max.			12 ms Max.	$t=0$ at 90 % $V_{CC}$	
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max.			$\pm 10 \times 10^{-6}$ Max. 10 years	+25 °C, First year, $V_{CC} = 1.8$ V, 2.5 V, 3.3 V	

**External dimensions**

(Unit:mm)

●SG-350



\*1 The terminal of #1 pin may look the same as #2 to #4 pin.

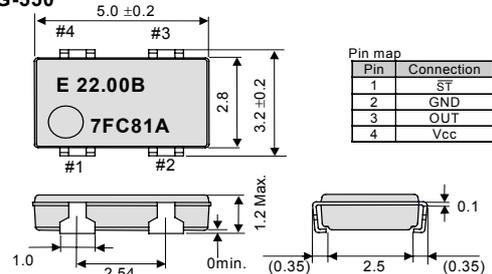
Note.

$\overline{ST}$  pin

$\overline{ST}$  pin = HIGH or "open" : Specified frequency output.

$\overline{ST}$  pin = LOW : Output is low level (weak pull - down), oscillation stops.(SCG)/ HI-z(SEF,SDF,SCF)

●SG-550



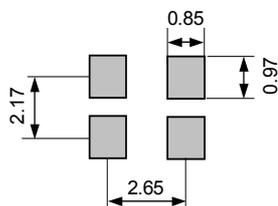
Metal may be exposed on the top or bottom of this product.

This will not affect any quality, reliability or electrical spec.

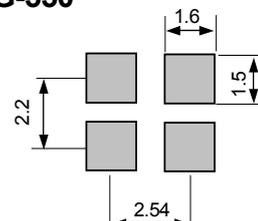
**Footprint (Recommended)**

(Unit:mm)

●SG-350



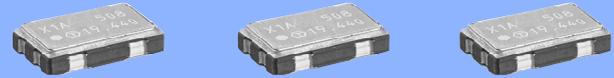
●SG-550



## CRYSTAL OSCILLATOR SPXO

# TCO-7106X1A TCO-7107X1A

- Frequency range : 1.5 MHz to 75 MHz
- Supply voltage : 3.3 V
- Frequency tolerance:  $\pm 100 \times 10^{-6}$  or  $50 \times 10^{-6}$
- Thickness : 1.2 mm Max.
- Function : Standby ( $\overline{ST}$ )
- Lead(Pb)-free : Lead free completely



Actual size

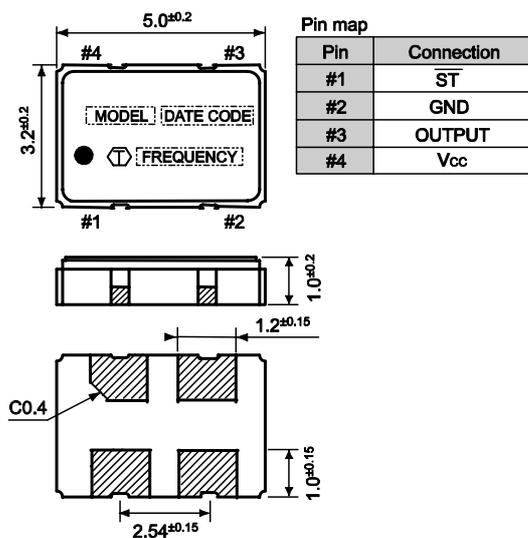


### Specifications (characteristics)

Item	Symbol	TCO-7106X1A	TCO-7107X1A	Remarks
Output frequency range	$f_o$	1.500 MHz to 75.000 MHz		Please contact us for inquiries regarding the available frequencies.
Supply voltage	V <sub>CC</sub>	3.3 V $\pm 0.33$ V		
Storage temperature range	T <sub>stg</sub>	-40 °C to +85 °C		
Operating temperature range	T <sub>use</sub>	0 °C to +70 °C		
Frequency tolerance	F <sub>tol(osc)</sub>	$\pm 50 \times 10^{-6}$ Max.	$\pm 100 \times 10^{-6}$ Max.	0 °C to +70 °C
Current consumption	I <sub>CC</sub>	20 mA Max.		No load condition
Symmetry	SYM	40 % to 60 %		50 % V <sub>CC</sub> level
High output voltage	V <sub>OH</sub>	90 % V <sub>CC</sub> Min.		I <sub>OH</sub> =-5 mA
Low output voltage	V <sub>OL</sub>	10 % V <sub>CC</sub> Max.		I <sub>OL</sub> =5 mA
Output load condition (CMOS)	L <sub>CMOS</sub>	15 pF Max.		
Output enable / disable input voltage	V <sub>IH</sub>	70 % V <sub>CC</sub> Min.		V <sub>IH</sub> or OPEN : Enable
	V <sub>IL</sub>	30 % V <sub>CC</sub> Max.		V <sub>IL</sub> or GND : Disable
Rise time / Fall time	t <sub>r</sub> / t <sub>f</sub>	6 ns Max.		10 % V <sub>CC</sub> to 90 % V <sub>CC</sub> level
Oscillation start up time	t <sub>osc</sub>	10 ms Max.		Time at minimum supply voltage to be 0 s
Frequency aging	F <sub>aging</sub>	$\pm 5 \times 10^{-6}$ / year Max.		+25 °C, V <sub>CC</sub> =3.3 V, First year

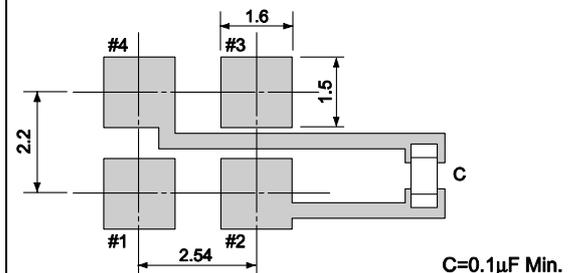
### External dimensions

(Unit:mm)



### Footprint (Recommended)

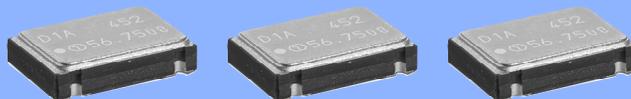
(Unit:mm)



**CRYSTAL OSCILLATOR  
SPXO**

**TCO-708x Series**

- Frequency range : 1.5 MHz to 135 MHz
- Supply voltage : 3.3 V or 5V
- Frequency tolerance:  $\pm 100 \times 10^{-6}$ ,  $\pm 50 \times 10^{-6}$ ,  $\pm 25 \times 10^{-6}$
- Thickness : 1.8 mm Max.
- Function : Standby ( $\overline{ST}$ )
- Lead(Pb)-free : Lead free completely



Actual size



**Specifications (characteristics)**

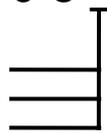
Item	Symbol	TCO-708*X1A*	TCO-708*D1A*	TCO-708*A1A*	Remarks
Output frequency range	$f_o$	1.500 MHz to 135.000 MHz	1.500 MHz to 75.000 MHz		Please contact us for inquiries regarding the available frequencies.
Supply voltage	V <sub>cc</sub>	3.3 V	5.0 V	3.3 V	As per below discription
Storage temperature range	T <sub>stg</sub>	-40 °C to +85 °C			
Operating temperature range	T <sub>use</sub>	As per below discription			
Frequency tolerance	F <sub>tol(osc)</sub>	As per below discription			
Current consumption	I <sub>cc</sub>	50 mA Max.			No load condition.
Symmetry	SYM	40 % to 60 %			50 % V <sub>cc</sub> level (708*X1A*,*D1A*) 1.4 V level (708*A1A*)
High output voltage	V <sub>OH</sub>	90 % V <sub>cc</sub> Min.		2.4 V Max.	
Low output voltage	V <sub>OL</sub>	10 % V <sub>cc</sub> Max.		0.4 V Min.	
Output load condition (TTL)	L <sub>TTL</sub>	—	—	2 TTL Max.	
Output load condition (CMOS)	L <sub>CMOS</sub>	15 pF Max.			
Output enable / disable input voltage	V <sub>IH</sub>	70 % V <sub>cc</sub> Min.			V <sub>IH</sub> or OPEN : Enable
	V <sub>IL</sub>	30 % V <sub>cc</sub> Max.			V <sub>IL</sub> or GND : Disable
Rise time / Fall time	t <sub>r</sub> / t <sub>f</sub>	10 ns Max.			10 % V <sub>cc</sub> to 90 % V <sub>cc</sub> level : (708*X1A*,*D1A*) 0.4 V to 2.4 V level : (708*A1A*)
Oscillation start up time	t <sub>osc</sub>	10 ms Max.			Time at minimum supply voltage to be 0 s
Frequency aging	F <sub>aging</sub>	$\pm 5 \times 10^{-6}$ / year Max.			+25 °C, First year

\* Part Number

**TCO - 7 0 8      1 A**

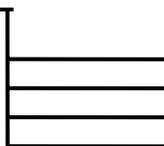
<Frequency tolerance / V<sub>cc</sub> tolerance>

- $\pm 25 \times 10^{-6}$  Max. / V<sub>cc</sub>  $\pm 5 \%$  : 5
- $\pm 50 \times 10^{-6}$  Max. / V<sub>cc</sub>  $\pm 10 \%$  : 6
- $\pm 100 \times 10^{-6}$  Max. / V<sub>cc</sub>  $\pm 10 \%$  : 7



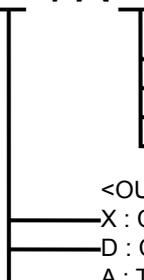
<Operating temperature range>

- BLANK: 0 °C to +70 °C
- 1: -10 °C to +70 °C
- 2: -20 °C to +70 °C
- 4: -40 °C to +85 °C ( $\pm 50$ ,  $\pm 100 \times 10^{-6}$  only)



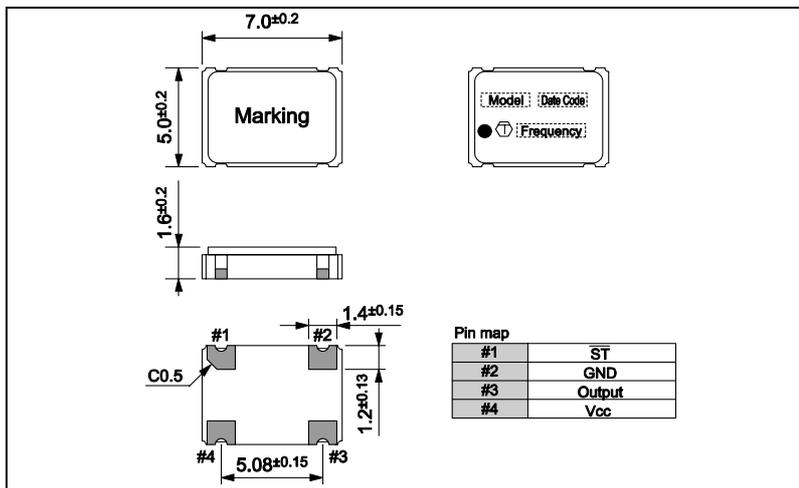
<OUTPUT / Supply voltage / Frequency range>

- X : CMOS / V<sub>cc</sub>= 3.3 V / 1.5 MHz to 135 MHz
- D : CMOS / V<sub>cc</sub>= 5.0 V / 1.5 MHz to 75 MHz
- A : TTL / V<sub>cc</sub>= 3.3 V / 1.5 MHz to 75 MHz



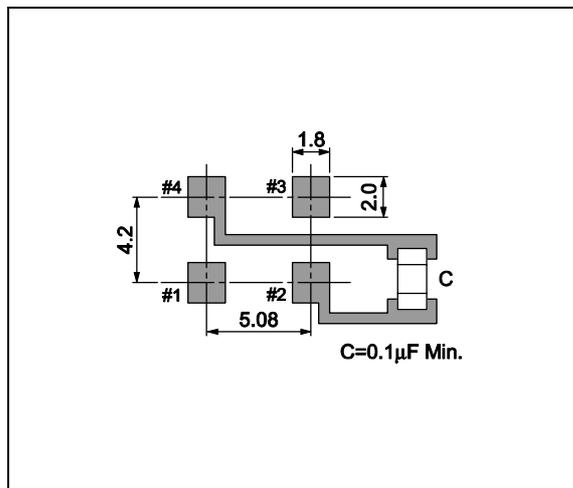
**External dimensions**

(Unit:mm)



**Footprint (Recommended)**

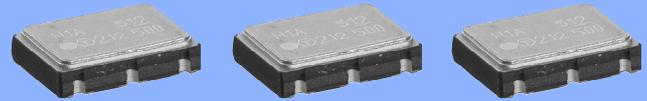
(Unit:mm)



## CRYSTAL OSCILLATOR SPXO

# TCO-7116H1A

- Frequency range : 50 MHz to 213 MHz
- Supply voltage : 3.3 V
- Output : LV-PECL
- Thickness : 1.8 mm Max.
- Function : Standby ( $\overline{ST}$ )
- Lead(Pb)-free : Lead free completely



Actual size

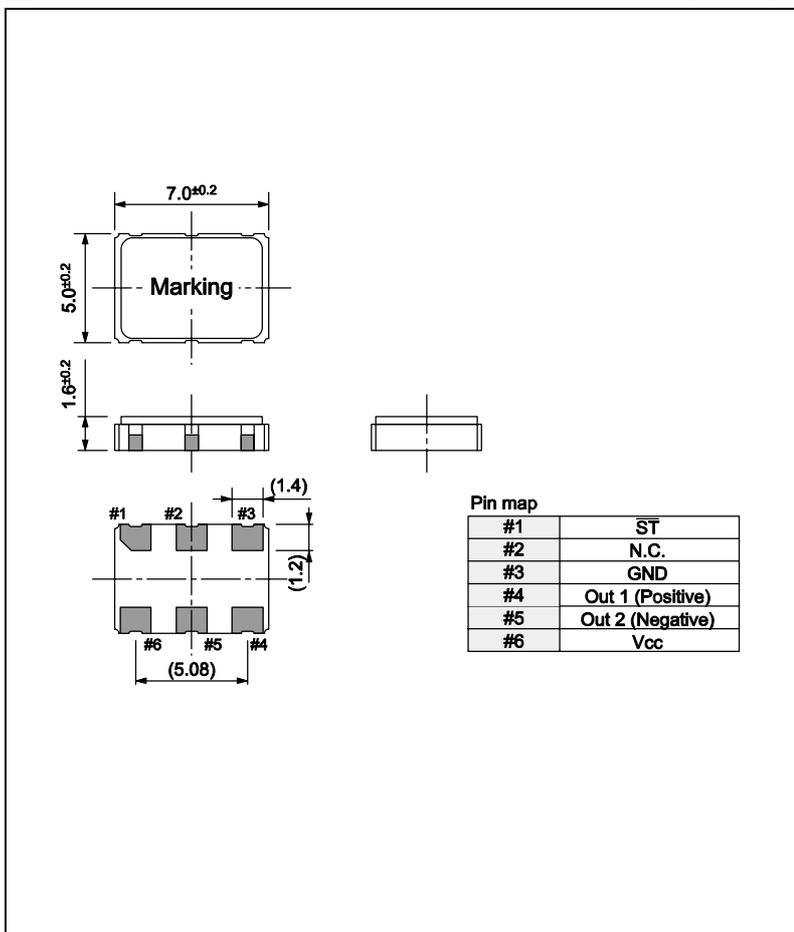


### Specifications (characteristics)

Item	Symbol	TCO-7116H1A	Remarks
Output frequency range	$f_o$	50.000 MHz to 213.000 MHz	Please contact us for inquiries regarding the available frequencies.
		125 MHz, 156.25 MHz, 212.5 MHz	Standard frequency
Supply voltage	V <sub>cc</sub>	3.3 V $\pm$ 0.165 V	
Storage temperature range	T <sub>stg</sub>	-40 °C to +85 °C	
Operating temperature range	T <sub>use</sub>	0 °C to +70 °C	
Frequency tolerance	F <sub>tol(osc)</sub>	$\pm 50 \times 10^{-6}$ Max.	0 °C to +70 °C
Current consumption	I <sub>cc</sub>	80 mA Max.	No load condition
Symmetry	SYM	40 % to 60 %	at outputs crossing point
High output voltage	V <sub>OH</sub>	V <sub>cc</sub> -1.0 V Min.	
Low output voltage	V <sub>OL</sub>	V <sub>cc</sub> -1.6 V Max.	
Output load condition (ECL)	L <sub>ECL</sub>	LV-PECL	
Output enable / desable input voltage	V <sub>IH</sub>	70 % V <sub>cc</sub> Min.	V <sub>IH</sub> or OPEN : Enable
	V <sub>IL</sub>	20 % V <sub>cc</sub> Max.	V <sub>IL</sub> or GND : Disable
Rise time / Fall time	t <sub>r</sub> / t <sub>f</sub>	1 ns Max.	20 % to 80 % (V <sub>OH</sub> -V <sub>OL</sub> )
Oscillation start up time	t <sub>osc</sub>	2 ms Max.	Time at minimum supply voltage to be 0 s
Frequency aging	F <sub>aging</sub>	$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, V <sub>cc</sub> =3.3 V, First year.

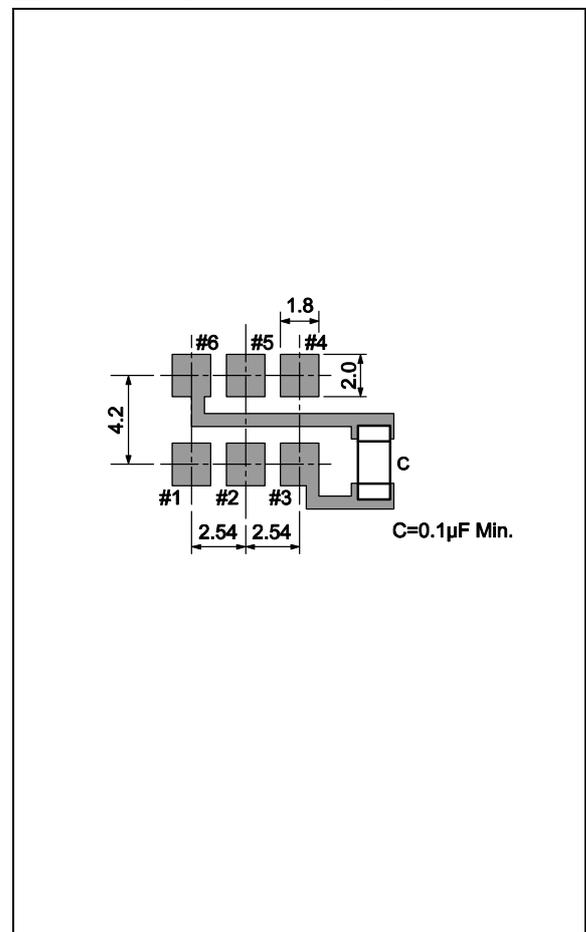
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



**CRYSTAL OSCILLATOR  
SPXO**

**SG-710 series**

- Frequency range : 1.8 MHz to 125 MHz
- Supply voltage : 3.3 V or 5.0 V
- Function : Output enable (OE) PTK,PHK  
Standby ( $\overline{ST}$ ) ECK
- Thickness : 1.3 mm Typ.
- Lead(Pb)-free : Lead free completely



Actual size

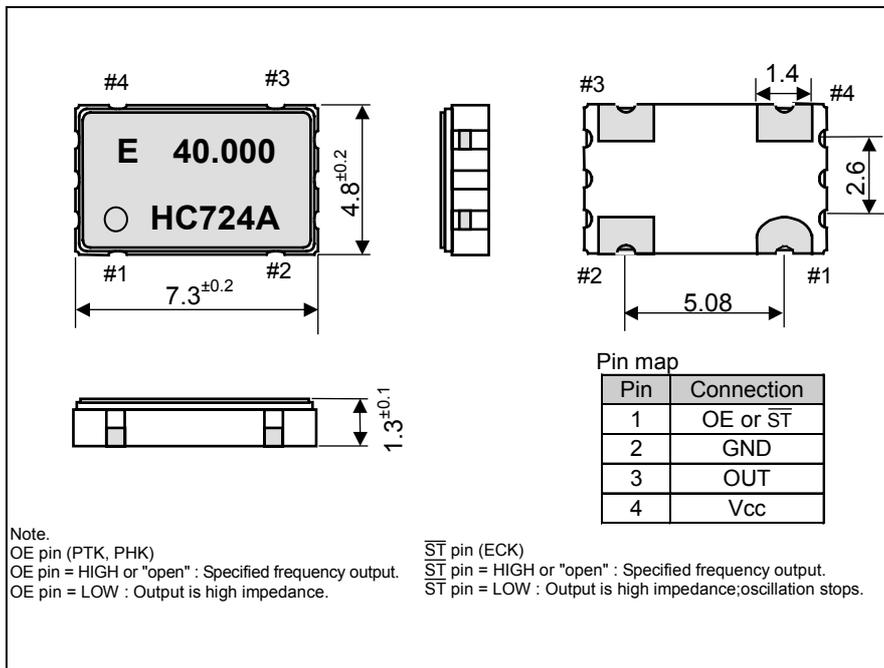


**Specifications (characteristics)**

Item	Symbol	Specifications			Remarks
		PTK	PHK	ECK	
Output frequency range	$f_0$	1.8 MHz to 50 MHz	1.8 MHz to 80 MHz	1.8 MHz to 125 MHz	
Supply voltage	V <sub>cc</sub>	5.0 V $\pm$ 0.5 V			3.3 V $\pm$ 0.3 V
Temperature range	Storage temperature	-55 °C to +125 °C			Stored as bare product after unpacking
	Operating temperature	-10 °C to +70 °C, -40 °C to +85 °C			
Frequency tolerance	F <sub>tol(osc)</sub>	S: $\pm 25 \times 10^{-6}$ , B: $\pm 50 \times 10^{-6}$ , C: $\pm 100 \times 10^{-6}$ L: $\pm 50 \times 10^{-6}$ , M: $\pm 100 \times 10^{-6}$			-10 °C to +70 °C -40 °C to +85 °C
Current consumption	I <sub>cc</sub>	13 mA Max.	15 mA Max.	8 mA Max.	$f_0 \leq 25$ MHz, No load condition. (ECK: $f_0 \leq 32$ MHz)
		24 mA Max.	26 mA Max.	15 mA Max.	$f_0 \leq 50$ MHz, No load condition
		—	34 mA Max.	18 mA Max.	$f_0 \leq 67$ MHz, No load condition
		—	40 mA Max.	22 mA Max.	$f_0 \leq 80$ MHz, No load condition
		—	—	30 mA Max.	$f_0 \leq 125$ MHz, No load condition
Output disable current	I <sub>dis</sub>	6 mA Max.	5 mA Max.	—	$f_0 \leq 25$ MHz, OE=GND (PTK, PHK)
		12 mA Max.	10 mA Max.	—	$f_0 \leq 50$ MHz, OE=GND (PTK, PHK)
		—	13 mA Max.	—	$f_0 \leq 67$ MHz, OE=GND (PTK, PHK)
		—	16 mA Max.	—	$f_0 \leq 80$ MHz, OE=GND (PTK, PHK)
Stand-by current	I <sub>std</sub>	—	—	13 $\mu$ A Max.	$\overline{ST}$ =GND(ECK)
Symmetry	SYM	—	45 % to 55 %	45 % to 55 %	1.8 MHz $\leq f_0 \leq 50$ MHz, CL=15 pF(ECK), 50 % V <sub>cc</sub>
		45 % to 55 %	—	40 % to 60 %	50 MHz $< f_0 \leq 125$ MHz, CL=15 pF(ECK), 50 % V <sub>cc</sub> 1.4 V level, 10TTL
High output voltage	V <sub>OH</sub>	2.4 V Min.	V <sub>cc</sub> -0.5 V Min.	90 % V <sub>cc</sub> Min.	I <sub>OH</sub> =-16 mA(PTK,PHK), -2 mA(ECK)
Low output voltage	V <sub>OL</sub>	0.4 V Max.	0.5 V Max.	10 % V <sub>cc</sub> Max.	I <sub>OL</sub> = 16 mA(PTK,PHK), 2 mA(ECK)
Output load condition(TTL)	L <sub>TTL</sub>	10 TTL Max.	10 TTL Max.	—	
Output load condition(CMOS)	L <sub>CMOS</sub>	15 pF Max.	50 pF Max.	15 pF Max.	
Output enable / disable input voltage	V <sub>IH</sub>	2.0 V Min.	2.0 V Min.	70 % V <sub>cc</sub> Min.	OE terminal (PTK, PHK)
	V <sub>IL</sub>	0.8 V Max.	0.8 V Max.	30 % V <sub>cc</sub> Max.	$\overline{ST}$ terminal (ECK)
Output rise and fall time	tr / tf	—	5 ns Max.	6 ns Max.	CMOS load: 10 % V <sub>cc</sub> to 90 % V <sub>cc</sub> level
		5 ns Max.	—	—	TTL load: 0.4 V to 2.4 V level
Oscillation start up time	t <sub>osc</sub>	10 ms Max.			Time at minimum supply voltage to be 0 s
Frequency aging	F <sub>aging</sub>	$\pm 5 \times 10^{-6}$ / year Max.			+25 °C, V <sub>cc</sub> =5.0 V / 3.3 V, First year.

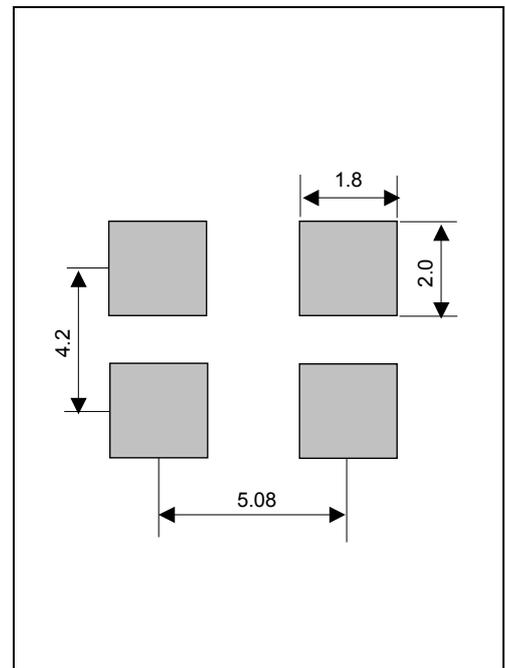
**External dimensions**

(Unit:mm)



**Footprint (Recommended)**

(Unit:mm)



## CRYSTAL OSCILLATOR SPXO

### SG - 645 series

- Frequency range : 32.001 MHz to 135 MHz
- Supply voltage : 3.3 V or 5.0 V
- Function : Output enable(OE) or Standby( $\overline{ST}$ )
- Thickness : 1.5 mm Max.
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.
- Pin compatible with ceramic package crystal oscillator (7 × 5)



Actual size

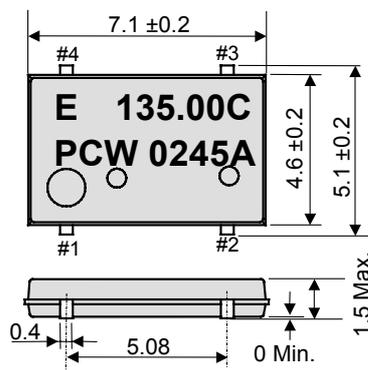


### Specifications (characteristics)

Item	Symbol	Specifications			Remarks
		PTW / STW	PHW / SHW	PCW / SCW	
Output frequency range	$f_o$	32.001 MHz to 135.000 MHz			
Supply voltage	$V_{CC}$	4.5 V to 5.5 V		3.0 V to 3.6 V	
Temperature range	Storage temperature	$T_{stg}$ : -55 °C to +125 °C			Stored as bare product after unpacking
	Operating temperature	$T_{use}$ : -20 °C to +70 °C		-40 °C to +85 °C	
Frequency tolerance	$F_{tol(osc)}$	B: $\pm 50 \times 10^{-6}$ , C: $\pm 100 \times 10^{-6}$			-20 °C to +70 °C
		—		M: $\pm 100 \times 10^{-6}$	-40 °C to +85 °C
Current consumption	$I_{CC}$	45 mA Max.		28 mA Max.	No load condition, Max. frequency.
Output disable current	$I_{dis}$	30 mA Max.		16 mA Max.	OE=GND(PTW,PHW,PCW)
Stand-by current	$I_{std}$	50 $\mu$ A Max.			$\overline{ST}$ =GND(STW,SHW,SCW)
Symmetry	SYM	—		40 % to 60 %	CMOS load: 50 % $V_{CC}$ level, $L_{CMOS}$ =Max.
		40 % to 60 %		—	TTL load: 1.4 V level, $L_{CMOS}$ =Max.
High output voltage	$V_{OH}$	$V_{CC}$ -0.4 V Min.			$I_{OH}$ =-16 mA(PTW,STW,PHW,SHW), -8 mA(PCW,SCW)
Low output voltage	$V_{OL}$	0.4 V Max.			$I_{OL}$ = 16 mA(PTW,STW,PHW,SHW), 8 mA(PCW,SCW)
Output load condition(TTL)	$L_{TTL}$	5 TTL Max.		—	Max. frequency , Max. Supply voltage.
Output load condition(CMOS)	$L_{CMOS}$	15 pF Max.			
Output enable / disable input voltage	$V_{IH}$	2.0 V Min.		70 % $V_{CC}$ Min.	OE terminal, $\overline{ST}$ terminal
	$V_{IL}$	0.8 V Max.		20 % $V_{CC}$ Max.	OE terminal, $\overline{ST}$ terminal
Output rise and fall time	$t_r / t_f$	—		4 ns Max.	CMOS load: 20 % $V_{CC}$ to 80 % $V_{CC}$ level, $L_{CMOS}$ ≤Max.
		4 ns Max.		—	TTL load: 0.4 V to 2.4 V level
Oscillation start up time	$t_{osc}$	10 ms Max.			Time at minimum supply voltage to be 0 s
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max.			+25 °C, $V_{CC}$ =5.0 V / 3.3 V, First year

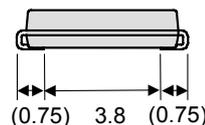
### External dimensions

(Unit:mm)



Pin map

Pin	Connection
1	OE or $\overline{ST}$
2	GND
3	OUT
4	$V_{CC}$



Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

#### Note.

OE pin (PTW, PHW, PCW)

OE pin = "H" or "open" : Specified frequency output.

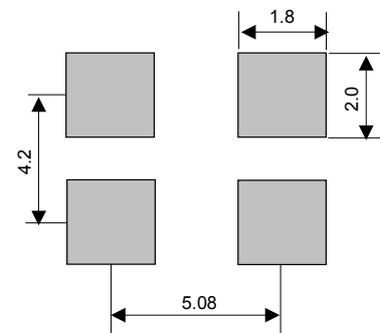
OE pin = "L" : Output is high impedance.

$\overline{ST}$  pin (STW, SHW, SCW)

$\overline{ST}$  pin = "H" or "open" : Specified frequency output.

$\overline{ST}$  pin = "L" : Output is low level (weak pull - down), oscillation stops.

### Footprint (Recommended) (Unit:mm)



## CRYSTAL OSCILLATOR SPXO

### SG - 636 series

- Frequency range : 2.21675 MHz to 135 MHz
- Supply voltage : 2.5 V / 3.3 V / 5.0 V
- Function : Output enable(OE) Standby( $\overline{ST}$ )
- Thickness : 2.7 mm Max.
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.



Actual size



#### Specifications (characteristics)

Item	Symbol	Specifications				Remarks
		PTF	PH	PCE / SCE	PDE	
Output frequency range	$f_0$	2.21675 MHz to 41.000 MHz	41.001 MHz to 70.000 MHz	2.21675 MHz to 40.000 MHz	2.21675 MHz to 40.000 MHz	
Supply voltage	$V_{CC}$	5.0 V $\pm$ 0.5 V		3.3 V $\pm$ 0.3 V	2.5 V $\pm$ 0.25 V	
Temperature range	Storage temperature	-55 °C to +100 °C				Stored as bare product after unpacking
	Operating temperature	-20 °C to +70 °C				
Frequency tolerance	$F_{tol(osc)}$	C: $\pm$ 100 $\times$ 10 <sup>-6</sup>				-20 °C to +70 °C
Current consumption	$I_{CC}$	17 mA Max.	35 mA Max.	9 mA Max.	5 mA Max.	No load condition
Output disable current	$I_{dis}$	10 mA Max.	20 mA Max.	5 mA Max.	3 mA Max.	OE=GND
Stand-by current	$I_{std}$	—		2 $\mu$ A Max.	—	$\overline{ST}$ =GND(SCE)
Symmetry	SYM	40 % to 60 %		45 % to 55 %		CMOS load:50 % $V_{CC}$ level
		45 % to 55 %		—		TTL load: 1.4 V level
High output voltage	$V_{OH}$	$V_{CC}$ -0.4 V Min.				$I_{OH}$ =-8 mA(PTF)/-4 mA(PH,SCE,PCE), /-3.2 mA(PDE)
Low output voltage	$V_{OL}$	0.4 V Max.				$I_{OL}$ =16 mA(PTF)/4mA(PH,SCE,PCE) /3.2 mA(PDE)
Output load condition (TTL)	$L_{TTL}$	10 TTL Max.	—			$L_{CMOS} \leq 15$ pF
Output load condition (CMOS)	$L_{CMOS}$	50 pF Max.	20 pF Max.( $\leq$ 55 MHz) 15 pF Max.( $>$ 55 MHz)	30 pF Max.	15 pF Max.	
Output enable / disable input voltage	$V_{IH}$	2.0 V Min.		80 % $V_{CC}$ Min.		OE Terminal, $\overline{ST}$ Terminal (SCE)
	$V_{IL}$	0.8 V Max.		20 % $V_{CC}$ Max.		
Output rise and fall time	$tr / tf$	7 ns Max.	5 ns Max.			CMOS load:20 % $V_{CC}$ to 80 % $V_{CC}$ level
		5 ns Max.	—			TTL load:0.4 V to 2.4 V level
Oscillation start up time	$t_{osc}$	4 ms Max.	10 ms Max.	4 ms Max.		Time at minimum supply voltage to be 0 s
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max.				+25 °C, $V_{CC}$ =5.0 V/3.3 V/2.5 V, First year

#### Specifications (characteristics)

Item	Symbol	Specifications			Remarks	
		PTG	PHG	PCG / SCG		
Output frequency range	$f_0$	2.21675 MHz to 33.000 MHz *1				
Supply voltage	$V_{CC}$	4.5 V to 5.5 V		2.7 V to 3.6 V		
Temperature range	Storage temperature	-55 °C to +100 °C				Stored as bare product after unpacking
	Operating temperature	-20 °C to +70 °C				
Frequency tolerance	$F_{tol(osc)}$	B: $\pm$ 50 $\times$ 10 <sup>-6</sup> C: $\pm$ 100 $\times$ 10 <sup>-6</sup>			-20 °C to +70 °C	
Current consumption	$I_{CC}$	25 mA Max.		12 mA Max.	No load condition	
Output disable current	$I_{dis}$	20 mA Max.		10 mA Max.	OE=GND (PTG,PHG,PCG)	
Stand-by current	$I_{std}$	—		50 $\mu$ A Max.	$\overline{ST}$ =GND (SCG)	
Symmetry	SYM	40 % to 60 %		45 % to 55 %	50 % $V_{CC}$ level, $L_{CMOS}$ =25 pF	
		2.4 V Min.		—	1.4 V level, $L_{CMOS}$ =25 pF	
High output voltage	$V_{OH}$	—		$V_{CC}$ -0.4 V Min.	$I_{OH}$ =-8 mA	
Low output voltage	$V_{OL}$	—		—	$I_{OH}$ =-16 mA	
		0.4 V Max.		—	$I_{OL}$ =8 mA	
Output load condition	$L_{CMOS}$	25 pF Max.			$I_{OL}$ =16 mA	
Output enable / disable input voltage	$V_{IH}$	2.0 V Min.		70 % $V_{CC}$ Min.	OE Terminal, $\overline{ST}$ Terminal	
	$V_{IL}$	0.8 V Max.		20 % $V_{CC}$ Max.		
Output rise and fall time	$tr / tf$	—	3.4 ns Max.	4 ns Max.	20 % $V_{CC}$ to 80 % $V_{CC}$ level, $L_{CMOS} \leq 25$ pF	
		2.4 ns Max.	—		TTL load:0.4 V to 2.4 V level, $L_{CMOS} \leq 25$ pF	
Oscillation start up time	$t_{osc}$	12 ms Max.			$t=0$ at 90 % $V_{CC}$	
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max.			+25 °C, $V_{CC}$ =5.0 V/ 3.3 V, First year	

\*1 4.1250 MHz <  $f_0$  < 4.4336 MHz, 8.2500 MHz <  $f_0$  < 8.8672 MHz, 16.500 MHz <  $f_0$  < 17.7344 MHz : Unavailable

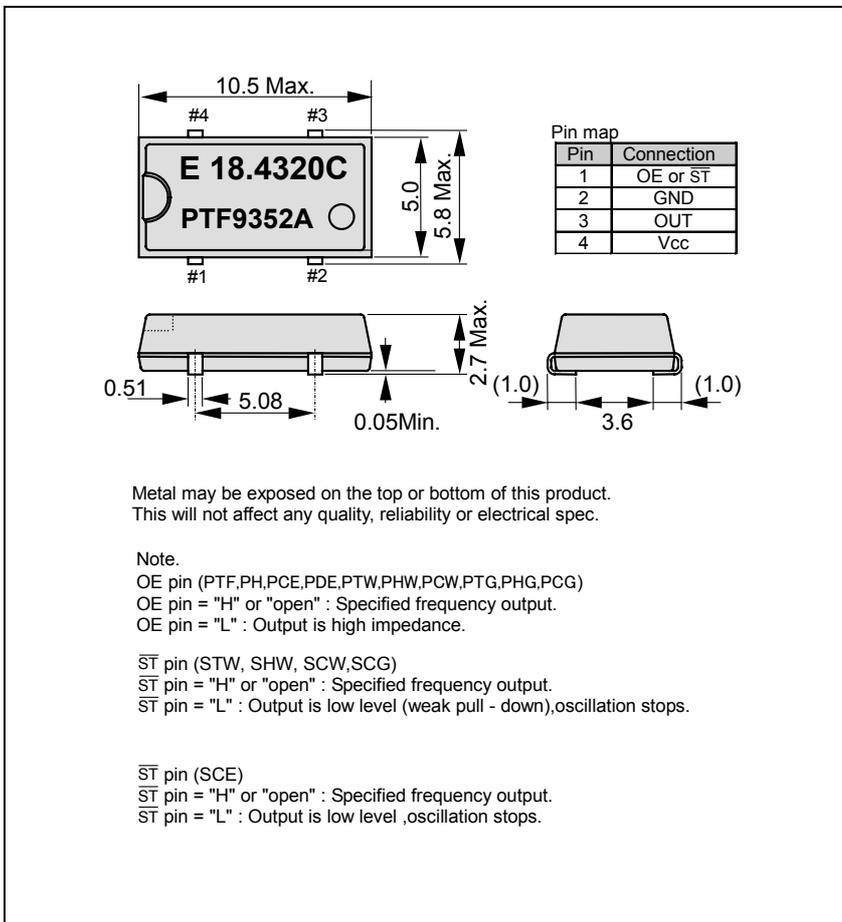
## Specifications (characteristics)

Item	Symbol	Specifications			Remarks
		PTW / STW	PHW / SHW	PCW / SCW	
Output frequency range	f <sub>o</sub>	32.001 MHz to 135.000 MHz			
Supply voltage	V <sub>cc</sub>	5.0 V ±0.5 V		3.3 V ±0.3 V	
Temperature range	Storage temperature	T <sub>stg</sub> -55 °C to +100 °C			Stored as bare product after unpacking
	Operating temperature	T <sub>use</sub> -20 °C to +70 °C			
Frequency tolerance	F <sub>tol(osc)</sub>	B: ±50 × 10 <sup>-6</sup> C: ±100 × 10 <sup>-6</sup>		-20 °C to +70 °C *1	
Current consumption	I <sub>cc</sub>	45 mA Max.		28 mA Max.	No load condition( Max. frequency range )
Output disable current	I <sub>dis</sub>	30 mA Max.		16 mA Max.	
Stand-by current	I <sub>std</sub>	50 µA Max.			$\overline{ST}$ = GND (STW,SHW,SCW)
Symmetry	SYM	—		40 % to 60 %	50 % V <sub>cc</sub> level, L <sub>CMOS</sub> =Max.
		40 % to 60 %		—	1.4 V level, L <sub>CMOS</sub> =Max.
High output voltage	V <sub>OH</sub>	V <sub>cc</sub> -0.4 V Min.			I <sub>OH</sub> =-16 mA(PTW , STW , PHW , SHW)/-8 mA(PCW , SCW)
Low output voltage	V <sub>OL</sub>	0.4 V Max.			I <sub>OL</sub> = 16 mA(PTW , STW , PHW , SHW)/ 8 mA(PCW , SCW)
Output load condition (TTL)	L <sub>TTL</sub>	5 TTL Max.	—	—	f <sub>o</sub> ≤ 90 MHz, Max. Supply voltage.
Output load condition (CMOS)	L <sub>CMOS</sub>	15 pF Max.			Max.frequency, Max.Supply voltage.
Output enable / disable input voltage	V <sub>IH</sub>	2.0 V Min.		70 % V <sub>cc</sub> Min.	OE Terminal , $\overline{ST}$ Terminal
	V <sub>IL</sub>	0.8 V Max.		20 % V <sub>cc</sub> Max.	
Output rise and fall time	tr / tf	—		4 ns Max.	20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level, L <sub>CMOS</sub> ≤ Max.
		4 ns Max.		—	—
Oscillation start up time	t <sub>osc</sub>	10 ms Max.			Time at minimum supply voltage to be 0 s
Frequency aging	F <sub>aging</sub>	±5 × 10 <sup>-6</sup> / year Max.			+25 °C, V <sub>cc</sub> =5.0 V / 3.3 V, First year

\*1 "C" tolerance : 40 MHz < f<sub>o</sub> ≤ 135 MHz

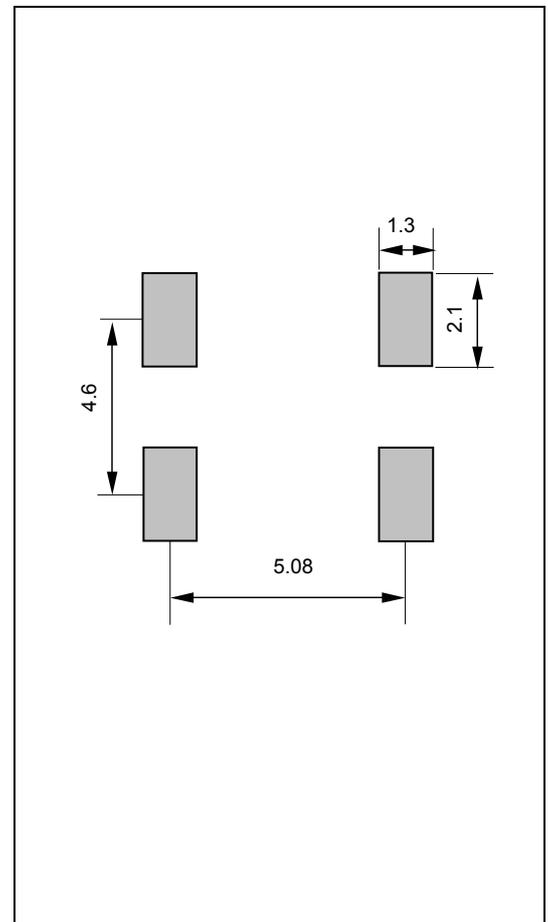
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)



## CRYSTAL OSCILLATOR SPXO

# SG-615/531/51 series

- Frequency range : 1.025 MHz to 135 MHz
- Supply voltage : 3.3 V / 5.0 V
- Function : Output enable(OE) Standby( $\overline{ST}$ )
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.
- Pin compatible with full-size metal can. (SG-51 series)
- Pin compatible with half-size metal can. (SG-531 series)



Actual size



### Specifications (characteristics)

Item	Symbol	Specifications			Remarks
		SG-615P SG-531P SG-51P	SG-615PTJ SG-531PTJ SG-51PTJ	SG-615PH SG-531PH SG-51PH	
Output frequency range	$f_o$	1.0250 MHz to 26 MHz	26.001 MHz to 66.667 MHz		.
Supply voltage	$V_{cc}$	5.0 V $\pm$ 0.5 V			
Temperature range	Storage temperature $T_{stg}$	-55 °C to +125 °C			Stored as bare product after unpacking
	Operating temperature $T_{use}$	-20 °C to +70 °C			
Frequency tolerance	$F_{tol(osc)}$	B: $\pm 50 \times 10^{-6}$ , C: $\pm 100 \times 10^{-6}$			-20 °C to +70 °C*1
Current consumption	$I_{cc}$	23 mA Max.	35 mA Max.		No load condition
Output disable current	$I_{dis}$	12 mA Max.	28 mA Max.	20 mA Max.	OE=GND
Symmetry	SYM	40 % to 60 %	—	40 % to 60 %	CMOS load:50 % $V_{cc}$ level TTL load: 1.4 V level
		40 % to 60 %	45 % to 55 %	—	
High output voltage	$V_{OH}$	$V_{cc}$ -0.4 V Min.	2.4 V Min.	$V_{cc}$ -0.4 V Min.	$I_{OH}$ =-400 $\mu$ A(P,PTJ)/-4 mA(PH)
Low output voltage	$V_{OL}$	0.4 V Max.			$I_{OL}$ =16 mA(P)/ 8 mA(PTJ)/ 4 mA(PH)
Output load condition (TTL)	$L_{TTL}$	10 TTL Max.	5 TTL Max.	—	$L_{CMOS} \leq 15$ pF
Output load condition (CMOS)	$L_{CMOS}$	50 pF Max.	—	50 pF Max.	
Output enable / disable input voltage	$V_{IH}$	2.0 V Min.	3.5 V Min.	2.0 V Min.	$I_{IH}$ = 1 $\mu$ A Max. (OE= $V_{cc}$ )
	$V_{IL}$	0.8 V Max.	1.5 V Max.	0.8 V Max.	$I_{IL}$ = -100 $\mu$ A Min. (OE=GND), PTJ: $I_{IL}$ = -500 $\mu$ A Min. (OE=GND)
Output rise and fall time	$t_r / t_f$	8 ns Max.	—	7 ns Max.	CMOS load:20 % $V_{cc}$ to 80 % $V_{cc}$ level TTL load:0.4 V to 2.4 V level
		8 ns Max.	5 ns Max.	—	
Oscillation start up time	$t_{osc}$	4 ms Max.	10 ms Max.		Time at minimum supply voltage to be 0 s
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max.			+25 °C, $V_{cc}$ =5.0 V, First year

\*1 "B" tolerance will be available up to 55 MHz.

### Specifications (characteristics)

Item	Symbol	Specifications			Remarks
		SG-615PCG SG-531PCG	SG-615SCG SG-531SCG	SG-615PCN	
Output frequency range	$f_o$	1.500 MHz to 26.000 MHz		26.001 MHz to 66.667 MHz	
Supply voltage	$V_{cc}$	2.7 V to 3.6 V		3.0 V to 3.6 V	
Temperature range	Storage temperature $T_{stg}$	-55 °C to +125 °C			Stored as bare product after unpacking
	Operating temperature $T_{use}$	-40 °C to +85 °C			
Frequency tolerance	$F_{tol(osc)}$	B: $\pm 50 \times 10^{-6}$ C: $\pm 100 \times 10^{-6}$ M: $\pm 100 \times 10^{-6}$			-20 °C to +70 °C -40 °C to +85 °C
Current consumption	$I_{cc}$	12 mA Max.		20 mA Max.	No load condition
Output disable current	$I_{dis}$	10 mA Max.	—	10 mA Max.	OE=GND (PCG,PCN)
Stand-by current	$I_{std}$	—	50 $\mu$ A Max.	—	$\overline{ST}$ =GND (SCG)
Symmetry	SYM	45 % to 55 %		50 % $V_{cc}$ level, $L_{CMOS}$ =Max.	
High output voltage	$V_{OH}$	$V_{cc}$ -0.4 V Min.		$V_{cc}$ -0.4 V Min.	$I_{OH}$ =-8 mA
Low output voltage	$V_{OL}$	0.4 V Max.		0.4 V Max.	$I_{OL}$ = 8 mA
Output load condition	$L_{CMOS}$	25 pF Max.		15 pF Max.	
Output enable / disable input voltage	$V_{IH}$	70 % $V_{cc}$ Min.		70 % $V_{cc}$ Min.	OE Terminal, $\overline{ST}$ Terminal
	$V_{IL}$	20 % $V_{cc}$ Max.		30 % $V_{cc}$ Max.	
Output rise and fall time	$t_r / t_f$	4 ns Max.			20 % $V_{cc}$ to 80 % $V_{cc}$ level, $L_{CMOS} \leq$ Max.
Oscillation start up time	$t_{osc}$	12 ms Max.		10 ms Max.	$t=0$ at 90% $V_{cc}$
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max.			+25 °C, $V_{cc}$ =3.3 V, First year

Specifications (characteristics)

Item	Symbol	Specifications			Remarks	
		SG-615PTW / STW SG-531PTW / STW	SG-615PHW / SHW SG-531PHW / SHW	SG-615PCW / SCW SG-531PCW / SCW		
Output frequency range	f <sub>0</sub>	55.001 MHz to 135.000 MHz		26.001 MHz to 135.000 MHz		
Supply voltage	V <sub>cc</sub>	5.0 V ±0.5 V		3.3 V ±0.3 V		
Temperature range	Storage temperature	-55 °C to +125 °C			Stored as bare product after unpacking	
	Operating temperature	-20 °C to +70 °C		-40 °C to +85 °C		
Frequency tolerance	F <sub>tol(osc)</sub>	B: ±50 × 10 <sup>-6</sup> , C: ±100 × 10 <sup>-6</sup>		M: ±100 × 10 <sup>-6</sup>	-20 °C to +70 °C *1 -40 °C to +85 °C	
		—		—	—	
Current consumption	I <sub>cc</sub>	45 mA Max.		28 mA Max.	No load condition( Max. frequency range )	
Output disable current	I <sub>dis</sub>	30 mA Max.		16 mA Max.	OE=GND (PTW,PHW,PCW)	
Stand-by current	I <sub>std</sub>	50 µA Max.			ST=GND (STW,SHW,SCW)	
Symmetry	SYM	—		40 % to 60 %	50 % V <sub>cc</sub> level, L <sub>CMOS</sub> =Max.	
		40 % to 60 %		—	—	1.4 V level, L <sub>CMOS</sub> =Max.
High output voltage	V <sub>OH</sub>	V <sub>cc</sub> -0.4 V Min.			I <sub>OH</sub> = 16 mA(PTW,STW,PHW,SHW), -8 mA(PCW,SCW)	
Low output voltage	V <sub>OL</sub>	0.4 V Max.			I <sub>OL</sub> = 16 mA(PTW,STW,PHW,SHW), 8 mA(PCW,SCW)	
Output load condition (TTL)	L <sub>TTL</sub>	5 TTL Max.	—	—	f <sub>0</sub> ≤ 90 MHz, Max.supply voltage	
Output load condition (CMOS)	L <sub>CMOS</sub>	15 pF Max.			Max.frequency, Max.supply voltage	
Output enable / disable input voltage	V <sub>IH</sub>	2.0 V Min.		70 % V <sub>cc</sub> Min.	OE Terminal, ST Terminal	
	V <sub>IL</sub>	0.8 V Max.		20 % V <sub>cc</sub> Max.		
Output rise and fall time	tr / tf	—			4 ns Max.	20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level, L <sub>CMOS</sub> ≤ Max. 0.4 V to 2.4 V level
		4 ns Max.		—	—	
Oscillation start up time	t <sub>osc</sub>	10 ms Max.			Time at minimum supply voltage to be 0 s	
Frequency aging	F <sub>aging</sub>	±5 × 10 <sup>-6</sup> / year Max.			+25 °C, V <sub>cc</sub> =5.0 V / 3.3 V, First year	

\*1 "C" tolerance : f<sub>0</sub> ≥66.667 MHz(PTW,STW,PHW,SHW)

External dimensions

(Unit:mm)

Footprint (Recommended)

(Unit:mm)

**● SG-615 Series**

**● SG-531 Series**

**● SG-51 Series**

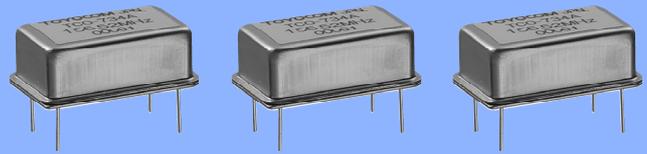
**● SG-615 Series**

Note.  
 OE pin (P,PTJ,PH,PTW,PHW,PCW,PCN,PCG)  
 OE pin = "H" or "open" : Specified frequency output.  
 OE pin = "L" : Output is high impedance.  
 ST pin (STW, SHW, SCW,SCG)  
 ST pin = "H" or "open" : Specified frequency output.  
 ST pin = "L" : Output is low level  
 (weak pull - down), oscillation stops.

## CRYSTAL OCILLATOR SPXO

# TCO-711A7

- Frequency range : 1.5 MHz to 100 MHz
- Supply voltage : 5.0 V
- Features : Hermetic double-sealed metal package
- Lead(Pb)-free : Contains Pb in this product exempted by RoHs directive.



Actual size



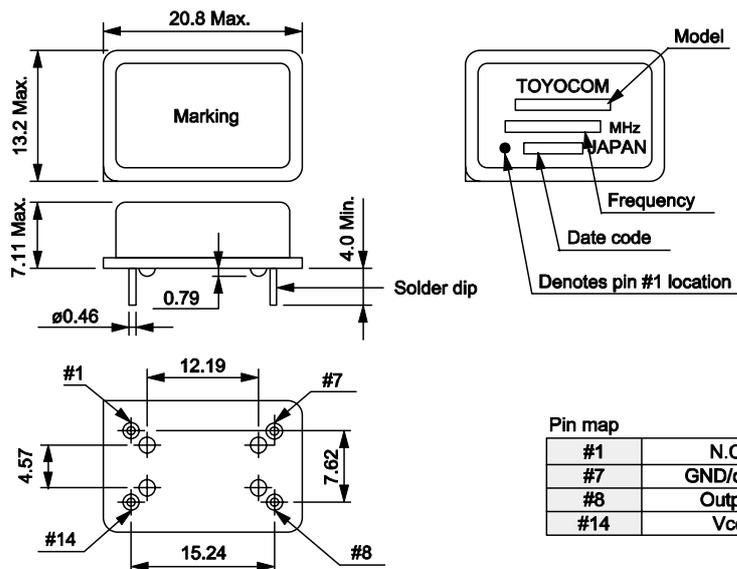
### Specifications (characteristics)

Item	Symbol	TCO-711A7	Remarks
Output frequency range	$f_o$	1.500 MHz to 100.000 MHz	Please contact us for inquiries regarding the available frequencies.
Supply voltage	$V_{CC}$	5.0 V $\pm$ 0.25 V	
Storage temperature range	$T_{stg}$	-40 °C to +85 °C	
Operating temperature range	$T_{use}$	0 °C to +70 °C	
Frequency tolerance	$F_{tol(osc)}$	$\pm 100 \times 10^{-6}$ Max.	0 °C to +70 °C
Current consumption	$I_{CC}$	90 mA Max.	No load condition.
Symmetry	SYM	40 % to 60 %	1.4 V level
High output voltage	$V_{OH}$	4.0 V Min.	
Low output voltage	$V_{OL}$	0.4 V Max.	
Output load condition (TTL)	$L_{TTL}$	5 TTL Max.	
Rise time / Fall time	$t_r / t_f$	15 ns Max.	0.4V to 2.4V level 10 % $V_{CC}$ to 90 % $V_{CC}$ level
Oscillation start up time	$t_{osc}$	10 ms Max.* <sup>1</sup>	Time at minimum supply voltage to be 0 s
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, $V_{CC}$ =5 V, First year.

\*1 Rise time (0 V to 4.75 V) of  $V_{CC} > 150 \mu s$

### External dimensions

(Unit:mm)



## CRYSTAL OSCILLATOR PROGRAMMABLE

### SG - 8002CE series

- Frequency range : 1 MHz to 125 MHz
- Supply voltage : 3.3 V or 5.0 V
- Function : Output enable(OE) or Standby( $\overline{ST}$ )
- Thickness : 1.05 mm Typ.
- Lead(Pb)-free : Lead free completely
- Short mass production lead time by PLL technology.
- SG-Writer available to purchase.  
Please contact EPSON TOYOCOM or local sales representative.



Actual size

### Specifications (characteristics)

Item	Symbol	Specifications *2			Remarks
		PT / ST	PH / SH	PC / SC	
Output frequency range	$f_0$	1 MHz to 125 MHz			$V_{CC}=4.5\text{ V to }5.5\text{ V}$
		—			$V_{CC}=3.0\text{ V to }3.6\text{ V}$
		—			$V_{CC}=2.7\text{ V to }3.6\text{ V}$
Supply voltage	$V_{CC}$	4.5 V to 5.5 V		2.7 V to 3.6 V	
Temperature range	Storage temperature	$T_{stg}$ -40 °C to +125 °C			Stored as bare product after unpacking
	Operating temperature	$T_{use}$ -20 °C to +70 °C (-40 °C to +85 °C)		-40 °C to +85 °C	Refer to "Frequency range"
Frequency tolerance	$F_{tol(osc)}$	B: $\pm 50 \times 10^{-6}$ , C: $\pm 100 \times 10^{-6}$ M: $\pm 100 \times 10^{-6}$			-20 °C to +70 °C -40 °C to +85 °C *3
Current consumption	$I_{CC}$	40 mA Max.		28 mA Max.	No load condition, Max. frequency
Output disable current	$I_{dis}$	30 mA Max.		16 mA Max.	OE=GND
Standby current	$I_{std}$	50 $\mu$ A Max.			$\overline{ST} = \text{GND}(\text{ST, SH, SC})$
Symmetry *1	SYM	—		40 % to 60 %	CMOS load: 50 % $V_{CC}$ level, Max. load condition
		40 % to 60 %		—	TTL load: 1.4 V, Max. load condition
High output voltage	$V_{OH}$	$V_{CC}-0.4\text{ V Min.}$			$I_{OH}=-16\text{ mA}(\text{PT, ST, PH, SH}), -8\text{ mA}(\text{PC, SC})$
Low output voltage	$V_{OL}$	0.4 V Max.			$I_{OL}=16\text{ mA}(\text{PT, ST, PH, SH}), 8\text{ mA}(\text{PC, SC})$
Output load condition (TTL) *1	$L_{TTL}$	5 TTL Max.	—		Max. frequency and Max. Supply voltage
Output load condition (CMOS) *1	$L_{CMOS}$	15 pF Max.			
Output enable / disable input voltage	$V_{IH}$	2.0 V Min.		70 % $V_{CC}$ Min.	$\overline{ST}$ , OE terminal
	$V_{IL}$	0.8 V Max.		20 % $V_{CC}$ Max.	$\overline{ST}$ , OE terminal
Output rise and fall time *1	$tr/ tf$	—		3 ns Max.	CMOS load: 20 % $V_{CC}$ to 80 % $V_{CC}$ level
		4 ns Max.		—	TTL load: 0.4 V to 2.4 V level
Oscillation start up time	$t_{osc}$	10 ms Max.			Time at minimum supply voltage to be 0 s
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max.			+25 °C, $V_{CC}=5.0\text{ V} / 3.3\text{ V}$ (PC, SC) First year

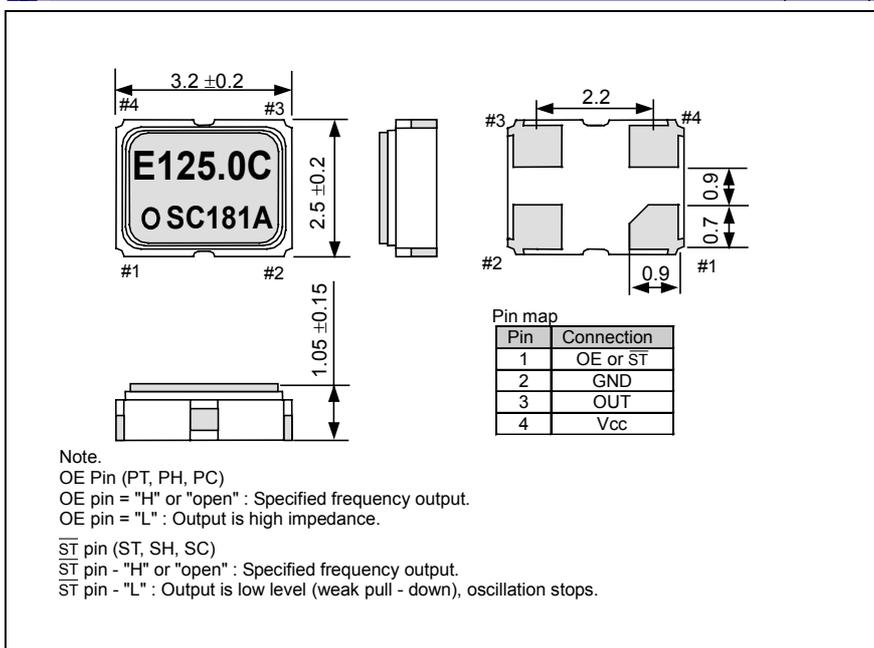
\*1 Operating temperature (-40 °C to +85 °C), the available frequency, symmetry and output load conditions, please refer to Page 48.

\*2 PLL-PLL connection & Jitter specification, please refer to Page 49.

\*3 PT / ST and PH / SH for "M" tolerance will be available up to 27 MHz. Checking possible by the Frequency checking program.

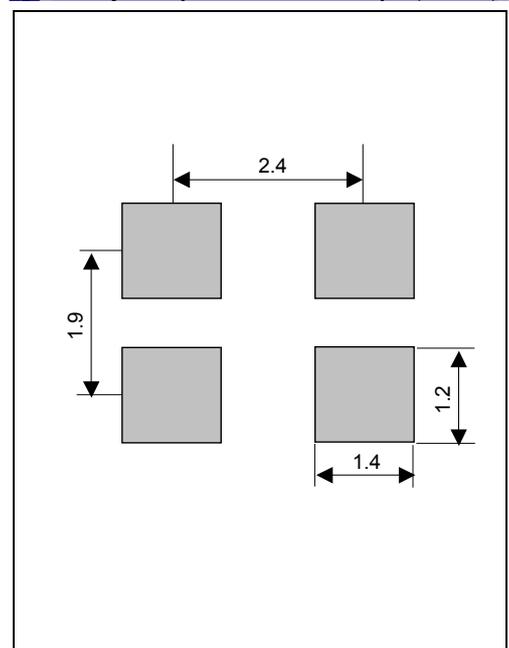
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



**CRYSTAL OSCILLATOR  
PROGRAMMABLE**

**SG - 8002LA / LB series**

- Frequency range : 1 MHz to 125 MHz
  - Supply voltage : 3.3 V or 5.0 V
  - Function : Output enable(OE) or Standby( $\overline{ST}$ )
  - Thickness : 1.15 mm Typ.(SG-8002LA)
  - Lead(Pb)-free : Lead free completely
  - Short mass production lead time by PLL technology.
  - SG-Writer available to purchase.
- Please contact EPSON TOYOCOM or local sales representative.



Actual size

SG-8002LA

SG-8002LB

**Specifications (characteristics)**

Item	Symbol	Specifications *2		Remarks
		PH / SH	PC / SC	
Output frequency range	$f_o$	1 MHz to 80 MHz	—	$V_{CC}=4.5\text{ V to }5.5\text{ V}$ $V_{CC}=3.0\text{ V to }3.6\text{ V}$
Supply voltage	$V_{CC}$	4.5 V to 5.5 V	2.7 V to 3.6 V	$V_{CC}=3.0\text{ V to }3.6\text{ V}$ $V_{CC}=2.7\text{ V to }3.6\text{ V}$
Temperature range	$T_{stg}$	-40 °C to +125 °C		Stored as bare product after unpacking
Operating temperature	$T_{use}$	-20 °C to +70 °C (-40 °C to +85 °C)		Refer to "Frequency range" (P4)
Frequency tolerance	$F_{tol(osc)}$	B: $\pm 50 \times 10^{-6}$ , C: $\pm 100 \times 10^{-6}$ M: $\pm 100 \times 10^{-6}$ *3		-20 °C to +70 °C -40 °C to +85 °C
Current consumption	$I_{CC}$	30 mA Max.	—	No load condition, $f_o=80\text{ MHz}$
Output disable current	$I_{dis}$	25 mA Max.	28 mA Max.	No load condition, $f_o=125\text{ MHz}$
Stand-by current	$I_{std}$	—	16 mA Max.	P Type only, $f_o=80\text{ MHz}$
		50 $\mu\text{A}$ Max.		P Type only, $f_o=125\text{ MHz}$
Symmetry *1	SYM	40 % to 60 %	—	S Type only, $\overline{ST} = \text{GND}$
		45 % to 55 %	—	50 % $V_{CC}$ , $L_{CMOS}=15\text{ pF}$ , $\leq 80\text{ MHz}$
		—	40 % to 60 %	50 % $V_{CC}$ , $L_{CMOS}=25\text{ pF}$ , $\leq 50\text{ MHz}$
		—	40 % to 60 %	50 % $V_{CC}$ , $L_{CMOS}=15\text{ pF}$ , $V_{CC}=3.0\text{ V to }3.6\text{ V}$ , $\leq 125\text{ MHz}$
		—	45 % to 55 %	50 % $V_{CC}$ , $L_{CMOS}=15\text{ pF}$ , $V_{CC}=2.7\text{ V to }3.6\text{ V}$ , $\leq 66.7\text{ MHz}$
High output voltage	$V_{OH}$	$V_{CC}-0.4\text{ V}$ Min.		$I_{OH}=-16\text{ mA(PH,SH)}$ , $-8\text{ mA(PC,SC)}$
Low output voltage	$V_{OL}$	0.4 V Max.		$I_{OL}=16\text{ mA(PH,SH)}$ , $8\text{ mA(PC,SC)}$
Output load condition(CMOS) *1	$L_{CMOS}$	15 pF Max.		Max. frequency and Max. supply voltage
Output enable / disable input voltage	$V_{IH}$	2.0 V Min.	70 % $V_{CC}$ Min.	$\overline{ST}$ , OE terminal
	$V_{IL}$	0.8 V Max.	20 % $V_{CC}$ Max.	$\overline{ST}$ , OE terminal
Output rise and fall time *1	$t_r / t_f$	3 ns Max.		20 % $V_{CC}$ to 80 % $V_{CC}$ level, $L_{CMOS}=\text{Max.}$
Oscillation start up time	$t_{osc}$	10 ms Max.		Time at minimum supply voltage to be 0 s
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-5}$ / year Max.		+25 °C, $V_{CC}=5.0\text{ V / }3.3\text{ V (PC / SC)}$ First year

\*1 Operating temperature (-40 °C to +85 °C), the available frequency, symmetry and output load conditions, please refer to Page 48.

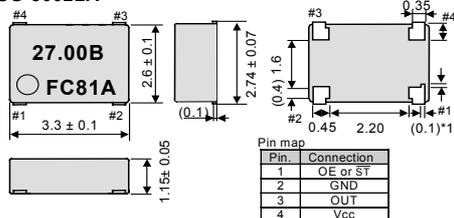
\*2 PLL-PLL connection & Jitter specification, please refer to Page 49.

\*3 PH,SH for "M" tolerance and "L" tolerance will be available up to 27 MHz. Checking possible by the Frequency checking program.

**External dimensions**

(Unit:mm)

● SG-8002LA



\*1 The terminal of #1 pin may look the same as #2 to #4 pin.

Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

Note.

OE pin (PH, PC)

OE pin = "H" or "open" : Specified frequency output.

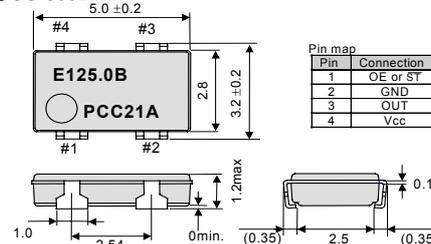
OE pin = "L" : Output is high impedance.

$\overline{ST}$  pin (SH, SC)

$\overline{ST}$  pin = "H" or "open" : Specified frequency output.

$\overline{ST}$  pin = "L" : Output is low level (weak pull - down), oscillation stops.

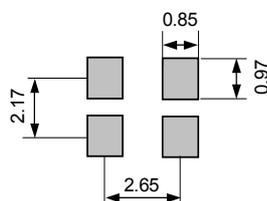
● SG-8002LB



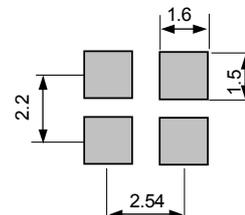
**Footprint (Recommended)**

(Unit:mm)

● SG-8002LA



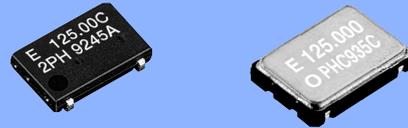
● SG-8002LB



## CRYSTAL OSCILLATOR PROGRAMMABLE

# SG-8002JF / CA series

- Frequency range : 1 MHz to 125 MHz
- Supply voltage : 3.3 V or 5.0 V
- Function : Output enable(OE) or Standby( $\overline{ST}$ )
- Thickness : 1.5 mm Max.
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive:SG-8002JF  
Lead free completely:SG-8002CA
- Pin compatible with ceramic package crystal oscillator (7 × 5)  
: SG-8002JF
- Short mass production lead time by PLL technology.
- SG-Writer available to purchase.  
Please contact EPSON TOYOCOM or local sales representative.



Actual size

SG-8002JF



SG-8002CA



### Specifications (characteristics)

Item	Symbol	Specifications *2			Remarks
		PT / ST	PH / SH	PC / SC	
Output frequency range	$f_o$	1 MHz to 125 MHz		—	$V_{CC}=4.5$ V to 5.5 V
		—		1 MHz to 125 MHz	$V_{CC}=3.0$ V to 3.6 V
		—		1 MHz to 66.7 MHz	$V_{CC}=2.7$ V to 3.6 V
Supply voltage	$V_{CC}$	4.5 V to 5.5 V		2.7 V to 3.6 V	
Temperature range	Storage temperature	$T_{stg}$ -55 °C to +125 °C			Stored as bare product after unpacking
	Operating temperature	$T_{use}$ -20 °C to +70 °C (-40 °C to +85 °C)		-40 °C to +85 °C	Refer to "Frequency range" (P.4)
Frequency tolerance	$F_{tol}(osc)$	B: $\pm 50 \times 10^{-6}$ , C: $\pm 100 \times 10^{-6}$ M: $\pm 100 \times 10^{-6}$			-20 °C to +70 °C -40 °C to +85 °C *3
Current consumption	$I_{CC}$	45 mA Max.		28 mA Max.	No load condition, Max. frequency range
Output disable current	$I_{dis}$	30 mA Max.		16 mA Max.	OE=GND(PT,PH,PC)
Stand-by current	$I_{std}$	50 $\mu$ A Max.			$\overline{ST}$ =GND(ST,SH,SC)
Symmetry*1	SYM	—		40 % to 60 %	CMOS load:50 % $V_{CC}$ level, Max. load condition
		40 % to 60 %		—	TTL load: 1.4V level, Max. load condition
High output voltage	$V_{OH}$	$V_{CC}-0.4$ V Min.			$I_{OH}=-16$ mA(PT / ST,PH / SH), -8 mA(PC / SC)
Low output voltage	$V_{OL}$	0.4 V Max.			$I_{OL}=16$ mA(PT / ST,PH / SH), 8 mA(PC / SC)
Output load condition (TTL) *1	$L_{TTL}$	5TTL Max.		—	$f_o \leq 90$ MHz, Max. supply voltage
Output load condition (CMOS) *1	$L_{CMOS}$	15 pF Max.		15 pF Max. (CA:25 pF Max.)	15 pF Max.
Output enable / disable input voltage	$V_{IH}$	2.0 V Min.		70 % $V_{CC}$ Min.	$\overline{ST}$ , OE terminal
	$V_{IL}$	0.8 V Max.		20 % $V_{CC}$ Max.	$\overline{ST}$ , OE terminal
Output rise and fall time *1	$t_r / t_f$	—		3 ns Max.	CMOS load: 20 % $V_{CC}$ to 80 % $V_{CC}$ level
		4 ns Max.		—	TTL load: 0.4 V to 2.4 V level
Oscillation start up time	$t_{osc}$	10 ms Max.			Time at minimum supply voltage to be 0 s
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max.			+25 °C, $V_{CC}=5.0$ V / 3.3 V (PC / SC) First year

\*1 Operating temperature (-40 °C to +85 °C), the available frequency, symmetry and output load conditions, please refer to Page 48.

\*2 PLL-PLL connection & Jitter specification, please refer to Page 49.

\*3 PT / ST and PH / SH for "M" tolerance will be available up to 55 MHz. (JF:40 MHz)

Checking possible by the Frequency Checking Program.

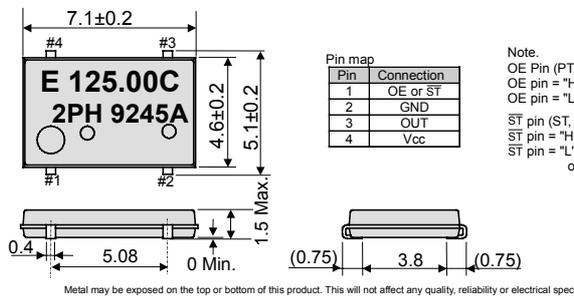
### External dimensions

(Unit:mm)

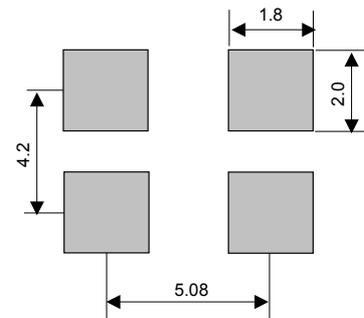
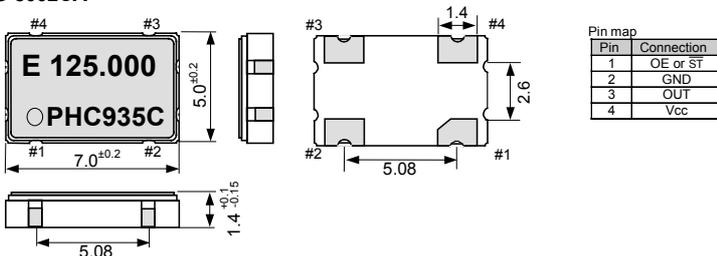
### Footprint (Recommended)

(Unit:mm)

#### ● SG-8002JF



#### ● SG-8002CA



**CRYSTAL OSCILLATOR  
PROGRAMMABLE**

**SG - 8002JC / JA series**

- Frequency range : 1 MHz to 125 MHz
  - Supply voltage : 3.3 V or 5.0 V
  - Function : Output enable(OE) or Standby( $\overline{ST}$ )
  - Thickness : 2.7 mm Max.(SG-8002JC)  
4.7 mm Max.(SG-8002JA)
- Package and pin compatible with SG-636 (SG-8002JC)  
Package and pin compatible with SG-615 (SG-8002JA)
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.
  - Short mass production lead time by PLL technology.
  - SG-Writer available to purchase.
- Please contact EPSON TOYOCOM or local sales representative.



Actual size

SG-8002JC

SG-8002JA



**Specifications (characteristics)**

Item	Symbol	Specifications *2			Remarks
		PT / ST	PH / SH	PC / SC	
Output frequency range	$f_0$	1 MHz to 125 MHz		—	$V_{CC}=4.5 V$ to $5.5 V$ $V_{CC}=3.0 V$ to $3.6 V$ $V_{CC}=2.7 V$ to $3.6 V$
Supply voltage	$V_{CC}$	4.5 V to 5.5 V		2.7 V to 3.6 V	
Temperature range	Storage temperature	$-55^{\circ}C$ to $+125^{\circ}C$ (JC: $-55^{\circ}C$ to $+100^{\circ}C$ )			Stored as bare product after unpacking
	Operating temperature	$T_{use}$	$-20^{\circ}C$ to $+70^{\circ}C$ ( $-40^{\circ}C$ to $+85^{\circ}C$ )	$-40^{\circ}C$ to $+85^{\circ}C$	Refer to "Frequency range" (P.4) SG-8002JC: $-20^{\circ}C$ to $+70^{\circ}C$ Only
Frequency tolerance	$F_{tol}(osc)$	B: $\pm 50 \times 10^{-6}$ , C: $\pm 100 \times 10^{-6}$ M: $\pm 100 \times 10^{-6}$		—	$-20^{\circ}C$ to $+70^{\circ}C$ $-40^{\circ}C$ to $+85^{\circ}C$ *3
Current consumption	$I_{CC}$	45 mA Max.		28 mA Max.	No load condition, Max. frequency
Output disable current	$I_{dis}$	30 mA Max.		16 mA Max.	OE=GND(PT,PH,PC)
Stand-by current	$I_{std}$	50 $\mu A$ Max.		—	$\overline{ST}$ =GND(ST,SH,SC)
Symmetry *1	SYM	—	40 % to 60 %		CMOS load: 50 % $V_{CC}$ level, Max. load condition
		40% to 60%		—	TTL load: 1.4V level, Max. load condition
High output voltage	$V_{OH}$	$V_{CC}-0.4 V$ Min.			$I_{OH}=-16 mA$ (PT,ST,PH,SH), $-8 mA$ (PC,SC)
Low output voltage	$V_{OL}$	0.4 V Max.			$I_{OL}=16 mA$ (PT,ST,PH,SH), $8 mA$ (PC,SC)
Output load condition (TTL) *1	$L_{TTL}$	5TTL Max.	—		$f_0 \leq 90 MHz$ and Max. Supply voltage
Output load condition (CMOS) *1	$L_{CMOS}$	15pF Max.			Max. frequency and Max. Supply voltage
Output enable / disable input voltage	$V_{IH}$	2.0 V Min.		70 % $V_{CC}$ Min.	$\overline{ST}$ , OE terminal
	$V_{IL}$	0.8 V Max.		20 % $V_{CC}$ Max.	$\overline{ST}$ , OE terminal
Output rise and fall time *1	$tr / tf$	—	3 ns Max.		CMOS load: 20 % $V_{CC}$ to 80 % $V_{CC}$ level
		4 ns Max.	—		TTL load: 0.4 V to 2.4 V level
Oscillation start up time	$t_{osc}$	10 ms Max.			Time at minimum supply voltage to be 0 s
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max.			$+25^{\circ}C, V_{CC}=5.0 V / 3.3 V$ (PC,SC) First year

\*1 Operating temperature ( $-40^{\circ}C$  to  $+85^{\circ}C$ ), the available frequency, symmetry and output load conditions, please refer to Page 48.

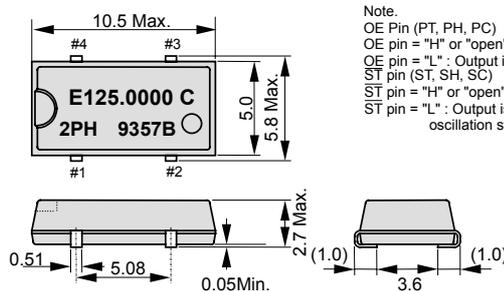
\*2 PLL-PLL connection & Jitter specification, please refer to Page 49.

\*3 PT / ST and PH / SH for "M" tolerance will be available up to 55 MHz.(Except:SG-8002JC )  
Checking possible by the Frequency Checking Program.

**External dimensions**

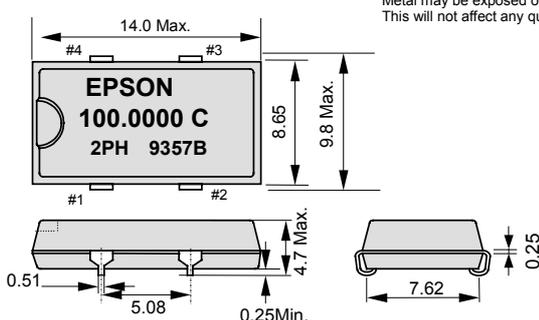
(Unit:mm)

● SG-8002JC



Pin	Connection
1	OE or $\overline{ST}$
2	GND
3	OUT
4	$V_{CC}$

● SG-8002JA

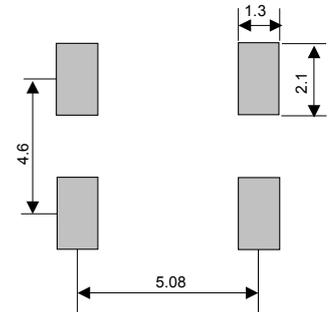


Pin	Connection
1	OE or $\overline{ST}$
2	GND
3	OUT
4	$V_{CC}$

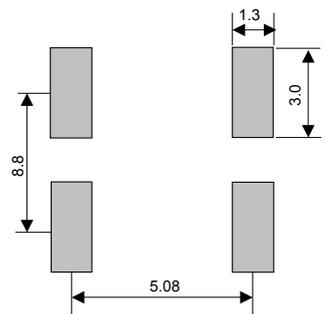
**Footprint (Recommended)**

(Unit:mm)

● SG-8002JC



● SG-8002JA



## CRYSTAL OSCILLATOR PROGRAMMABLE

# SG-8002DC / DB series

- Frequency range : 1 MHz to 125 MHz
- Supply voltage : 3.3 V or 5.0 V
- Function : Output enable(OE) or Standby( $\overline{ST}$ )  
Pin compatible with full size and half size.
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.
- Short mass production lead time by PLL technology.
- SG-Writer available to purchase.  
Please contact EPSON TOYOCOM or local sales representative.



Actual size

SG-8002DC



SG-8002DB



### Specifications (characteristics)

Item	Symbol	Specifications *2			Remarks	
		PT / ST	PH / SH	PC / SC		
Output frequency range	$f_o$	1 MHz to 125 MHz		—	V <sub>CC</sub> =4.5 V to 5.5 V V <sub>CC</sub> =3.0 V to 3.6 V	
Supply voltage	V <sub>CC</sub>	4.5 V to 5.5 V		2.7 V to 3.6 V	V <sub>CC</sub> =2.7 V to 3.6 V	
Temperature range	Storage temperature	-55 °C to +125 °C			Stored as bare product after unpacking	
	Operating temperature	-20 °C to +70 °C (-40 °C to +85 °C)		-40 °C to +85 °C	Refer to "Frequency range" (P.4)	
Frequency tolerance	F <sub>tol(osc)</sub>	B: $\pm 50 \times 10^{-6}$ , C: $\pm 100 \times 10^{-6}$ M: $\pm 100 \times 10^{-6}$			-20 °C to +70 °C -40 °C to +85 °C *3	
Current consumption	I <sub>DD</sub>	45 mA Max.		28 mA Max.	No load condition, Max. frequency	
Output disable current	I <sub>dis</sub>	30 mA Max.		16 mA Max.	OE=GND(PT,PH,PC)	
Stand-by current	I <sub>std</sub>	50 $\mu$ A Max.			$\overline{ST}$ =GND(ST,SH,SC)	
Symmetry *1	SYM	—	40 % to 60 %		CMOS load:50%V <sub>CC</sub> level, Max. load condition TTL load: 1.4V level, Max. load condition	
		40 % to 60 %		—		
High output voltage	V <sub>OH</sub>	V <sub>CC</sub> -0.4 V Min.			I <sub>OH</sub> =-16 mA(PT,ST,PH,SH), -8 mA(PC,SC)	
Low output voltage	V <sub>OL</sub>	0.4 V Max.			I <sub>OL</sub> =16 mA(PT,ST,PH,SH), 8 mA(PC,SC)	
Output load condition (TTL) *1	L <sub>TTL</sub>	5 TTL Max.		—	Max. frequency and Max. supply voltage	
Output load condition (CMOS) *1	L <sub>CMOS</sub>	15 pF Max.		25 pF Max.	15 pF Max.	
Output enable / disable input voltage	V <sub>IH</sub>	2.0 V Min.		70 % V <sub>CC</sub> Min.	$\overline{ST}$ , OE terminal	
	V <sub>IL</sub>	0.8 V Max.		20 % V <sub>CC</sub> Max.	$\overline{ST}$ , OE terminal	
Output rise and fall time *1	tr / tf	—			3 ns Max.	CMOS load: 20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> level TTL load: 0.4 V to 2.4 V level
		4 ns Max.		—	—	
Oscillation start up time	t <sub>osc</sub>	—			10 ms Max.	Time at minimum supply voltage to be 0 s
Frequency aging	F <sub>aging</sub>	—			$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, V <sub>CC</sub> =5.0 V / 3.3 V (PC/SC) First year

\*1 Operating temperature (-40 °C to +85 °C), the available frequency, symmetry and output load conditions, please refer to Page 48.

\*2 PLL-PLL connection & Jitter specification, please refer to Page 49.

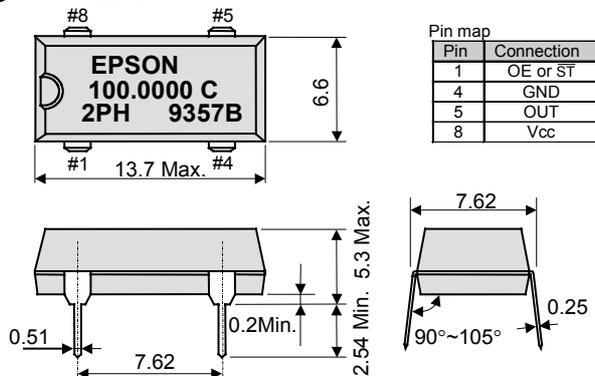
\*3 PT / ST and PH / SH for "M" tolerance will be available up to 55 MHz.

Checking possible by the Frequency Checking Program.

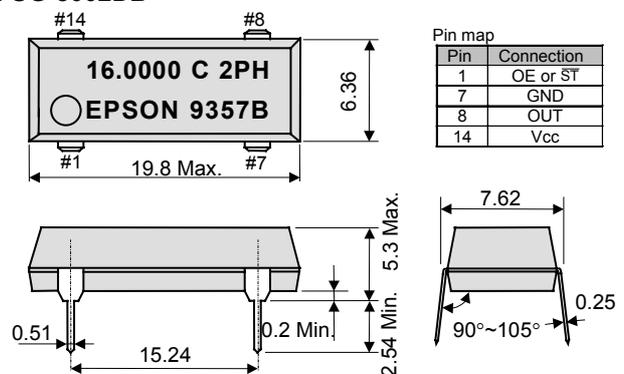
### External dimensions

(Unit:mm)

#### ● SG-8002DC



#### ● SG-8002DB



Note.

OE Pin (PT, PH, PC)

OE pin = "H" or "open" : Specified frequency output.

OE pin = "L" : Output is high impedance.

$\overline{ST}$  pin (ST, SH, SC)

ST pin = "H" or "open" : Specified frequency output.

ST pin = "L" : Output is low level (weak pull - down), oscillation stops.

## SG-8002 Series Specifications

Page	Item Model	Current Consumption	Supply Voltage	Output load condition	Output rise time Output fall time	Symmetry	Function	
44	SG-8002LA (SON 4-pin)	PH	35 mA Max.	4.5 V to 5.5 V	15 pF	3.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS=Max.)	40 % to 60 % (50 % V <sub>CC</sub> , L_CMOS=15 pF, f <sub>0</sub> =80 MHz/-20°C to +85°C)	OE
		SH						ST
	SG-8002LB (SOJ 4-pin)	PC	28 mA Max.	3.0 V to 3.6 V (2.7 V to 3.6 V)	15 pF	3.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS=Max.)	45 % to 55 % (50 % V <sub>CC</sub> , L_CMOS=15 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>0</sub> ≤40 MHz) 40 % to 60 % (50 % V <sub>CC</sub> , L_CMOS=15 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>0</sub> ≤125 MHz) ↑ (50 % V <sub>CC</sub> , L_CMOS=15 pF, V <sub>CC</sub> =2.7 V to 3.6 V, f <sub>0</sub> ≤66.7 MHz)	OE
		SC						ST
45 46 47	SG-8002CA (SON)	PT	45 mA Max.	4.5 V to 5.5 V	5 TTL+15 pF (f <sub>0</sub> ≤125MHz/-20°C to +70°C) 25 pF (f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C)	2.0 ns Max. (0.8 V to 2.0 V, L_CMOS or L_TTL=Max.)	45 % to 55 % (1.4 V <sub>L_TTL</sub> =5 TTL+15 pF, f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C) ↑ (1.4 V <sub>L_TTL</sub> =5 TTL+15 pF, f <sub>0</sub> ≤40.0 MHz/-40°C to +85°C)	OE
		ST			4.0 ns Max. (0.4 V to 2.4 V, L_CMOS or L_TTL=Max.)	40 % to 60 % (1.4 V <sub>L_TTL</sub> =5 TTL+15 pF, f <sub>0</sub> ≤125 MHz/-20°C to +70°C) ↑ (1.4 V <sub>L_CMOS</sub> =25 pF, f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C) ↑ (1.4 V <sub>L_CMOS</sub> =15 pF, f <sub>0</sub> ≤55.0 MHz/-40°C to +85°C)	ST	
	PH	25 pF (f <sub>0</sub> ≤125 MHz/-20°C to +70°C) 50 pF (f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C)	3.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS≤25)	45 % to 55 % (50 % V <sub>CC</sub> , L_CMOS=25 pF, f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C) ↑ (50 % V <sub>CC</sub> , L_CMOS=25 pF, f <sub>0</sub> ≤40.0 MHz/-40°C to +85°C)	OE			
	SH	15 pF (f <sub>0</sub> ≤55 MHz/-40°C to +85°C) 25 pF (f <sub>0</sub> ≤40 MHz/-40°C to +85°C)	4.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS=Max.)	40 % to 60 % (50 % V <sub>CC</sub> , L_CMOS=25 pF, f <sub>0</sub> ≤125 MHz/-20°C to +70°C) ↑ (50 % V <sub>CC</sub> , L_CMOS=25 pF, f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C) ↑ (50 % V <sub>CC</sub> , L_CMOS=15 pF, f <sub>0</sub> ≤55.0 MHz/-40°C to +85°C)	ST			
SG-8002DC (DIP 8-pin)	PC	28 mA Max.	3.0 V to 3.6 V (2.7 V to 3.6 V)	15 pF (f <sub>0</sub> ≤66.7 MHz/2.7 to 3.6 V) 15 pF (f <sub>0</sub> ≤125 MHz/3.0 to 3.6 V) 30 pF (f <sub>0</sub> ≤40 MHz/3.0 to 3.6 V)	3.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS≤15)	45 % to 55 % (50 % V <sub>CC</sub> , L_CMOS=30 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>0</sub> ≤40 MHz) 40 % to 60 % (50 % V <sub>CC</sub> , L_CMOS=15 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>0</sub> ≤125 MHz) ↑ (50 % V <sub>CC</sub> , L_CMOS=15 pF, V <sub>CC</sub> =2.7 V to 3.6 V, f <sub>0</sub> ≤66.7 MHz)	OE	
	SC			4.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS=Max.)	ST			
46	SG-8002JC (SOJ 4-pin)	PT	45 mA Max.	4.5 V to 5.5 V	5TTL + 15 pF (f <sub>0</sub> ≤90 MHz/-20 to +70°C) 15 pF (f <sub>0</sub> ≤125 MHz/-20°C to +70°C) 25 pF (f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C)	2.0 ns Max. (0.8 V to 2.0 V, L_CMOS or L_TTL=Max.)	45 % to 55 % (1.4 V <sub>L_TTL</sub> =5 TTL+15 pF, f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C) 40 % to 60 % (1.4 V <sub>L_TTL</sub> =5 TTL+15 pF, f <sub>0</sub> ≤90.0 MHz/-20°C to +70°C) ↑ (1.4 V <sub>L_CMOS</sub> =25 pF, f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C) ↑ (1.4 V <sub>L_CMOS</sub> =15 pF, f <sub>0</sub> ≤125 MHz/-20°C to +70°C)	OE
		ST			4.0 ns Max. (0.4 V to 2.4 V, L_CMOS or L_TTL=Max.)	ST		
		PH			15 pF (f <sub>0</sub> ≤125 MHz/-20°C to +70°C) 25 pF (f <sub>0</sub> ≤90 MHz/-20°C to +70°C)	3.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS≤25)	45 % to 55 % (50 % V <sub>CC</sub> , L_CMOS=25 pF, f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C) 40 % to 60 % (50 % V <sub>CC</sub> , L_CMOS=15 pF, f <sub>0</sub> ≤125 MHz/-20°C to +70°C) ↑ (50 % V <sub>CC</sub> , L_CMOS=25 pF, f <sub>0</sub> ≤90 MHz/-20°C to +70°C) ↑ (50 % V <sub>CC</sub> , L_CMOS=50 pF, f <sub>0</sub> ≤50 MHz/-20°C to +70°C)	OE
		SH			50 pF (f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C)	4.0 ns Max. (20 % V <sub>V</sub> to 80 % V <sub>CC</sub> , L_CMOS=Max.)	40 % to 60 % (50 % V <sub>CC</sub> , L_CMOS=50 pF, f <sub>0</sub> ≤50 MHz/-20°C to +70°C) ↑	ST
	PC	28 mA Max.	3.0 V to 3.6 V (2.7 V to 3.6 V)	15 pF (f <sub>0</sub> ≤66.7 MHz/2.7 to 3.6 V) 15 pF (f <sub>0</sub> ≤125 MHz/3.0 to 3.6 V) 30 pF (f <sub>0</sub> ≤40 MHz/3.0 to 3.6 V)	3.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS≤15)	45 % to 55 % (50 % V <sub>CC</sub> , L_CMOS=30 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>0</sub> ≤40 MHz) 40 % to 60 % (50 % V <sub>CC</sub> , L_CMOS=15 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>0</sub> ≤125 MHz) ↑ (50 % V <sub>CC</sub> , L_CMOS=15 pF, V <sub>CC</sub> =2.7 V to 3.6 V, f <sub>0</sub> ≤66.7 MHz)	OE	
				SC	4.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS=Max.)	ST		
45	SG-8002JF (SOJ 4-pin)	PT	45 mA Max.	4.5 V to 5.5 V	15 pF (f <sub>0</sub> ≤125 MHz/-20°C to +70°C) 25 pF (f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C)	2.0 ns Max. (0.8 V to 2.0 V, L_CMOS ≤25)	45 % to 55 % (1.4 V <sub>L_TTL</sub> =5 TTL+15 pF, f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C) 40 % to 60 % (1.4 V <sub>L_TTL</sub> =5 TTL+15 pF, f <sub>0</sub> ≤90 MHz/-20°C to +70°C) ↑ (1.4 V <sub>L_CMOS</sub> =25 pF, f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C) ↑ (1.4 V <sub>L_CMOS</sub> =15 pF, f <sub>0</sub> ≤125 MHz/-20°C to +70°C) ↑ (1.4 V <sub>L_CMOS</sub> =15 pF, f <sub>0</sub> ≤40 MHz/-40°C to +85°C)	OE
		ST			4.0 ns Max. (0.4 V to 2.4 V, L_CMOS or L_TTL=Max.)	ST		
		PH			15 pF (f <sub>0</sub> ≤125 MHz/-20°C to +70°C) 25 pF (f <sub>0</sub> ≤90 MHz/-20°C to +70°C)	3.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS≤25)	45 % to 55 % (50 % V <sub>CC</sub> , L_CMOS=25 pF, f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C) 40 % to 60 % (50 % V <sub>CC</sub> , L_CMOS=25 pF, f <sub>0</sub> ≤90.0 MHz/-20°C to +70°C) ↑ (50 % V <sub>CC</sub> , L_CMOS=50 pF, f <sub>0</sub> ≤50.0 MHz/-20°C to +70°C)	OE
		SH			50 pF (f <sub>0</sub> ≤50 MHz/-20°C to +70°C) 15 pF (f <sub>0</sub> ≤40 MHz/-40°C to +85°C)	4.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS=Max.)	40 % to 60 % (50 % V <sub>CC</sub> , L_CMOS=15 pF, f <sub>0</sub> ≤125 MHz/-20°C to +70°C) ↑ (50 % V <sub>CC</sub> , L_CMOS=15 pF, f <sub>0</sub> ≤40 MHz/-40°C to +85°C)	ST
	PC	28 mA Max.	3.0 V to 3.6 V (2.7 V to 3.6 V)	15 pF (f <sub>0</sub> ≤66.7 MHz/2.7 to 3.6 V) 15 pF (f <sub>0</sub> ≤125 MHz/3.0 to 3.6 V) 30 pF (f <sub>0</sub> ≤40 MHz/3.0 to 3.6 V)	3.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS≤15)	45 % to 55 % (50 % V <sub>CC</sub> , L_CMOS=30 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>0</sub> ≤40 MHz) 40 % to 60 % (50 % V <sub>CC</sub> , L_CMOS=15 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>0</sub> ≤125 MHz) ↑ (50 % V <sub>CC</sub> , L_CMOS=15 pF, V <sub>CC</sub> =2.7 V to 3.6 V, f <sub>0</sub> ≤66.7 MHz)	OE	
				SC	4.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS=Max.)	ST		
43	SG-8002CE (SON)	PT	40 mA Max.	4.5 V to 5.5 V	5 TTL+15 pF (f <sub>0</sub> ≤125 MHz/-20°C to +70°C) 5 TTL+15 pF (f <sub>0</sub> ≤27 MHz/-40°C to +85°C)	2.0 ns Max. (0.8 V to 2.0 V, L_TTL=Max.)	45 % to 55 % (1.4 V <sub>L_TTL</sub> =5 TTL+15 pF, f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C) ↑ (1.4 V <sub>L_TTL</sub> =5 TTL+15 pF, f <sub>0</sub> ≤27.0 MHz/-40°C to +85°C)	OE
		ST			4.0 ns Max. (0.4 V to 2.4 V, L_TTL=Max.)	40 % to 60 % (1.4 V <sub>L_TTL</sub> =5 TTL+15 pF, f <sub>0</sub> ≤125 MHz/-20°C to +70°C)	ST	
		PH			15 pF (f <sub>0</sub> ≤125 MHz/-20°C to +70°C) 25 pF (f <sub>0</sub> ≤100 MHz/-20°C to +70°C)	3.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS=Max.)	45 % to 55 % (50 % V <sub>CC</sub> , L_CMOS=25 pF, f <sub>0</sub> ≤66.7 MHz/-20°C to +70°C) ↑ (50 % V <sub>CC</sub> , L_CMOS=25 pF, f <sub>0</sub> ≤27.0 MHz/-40°C to +85°C)	OE
		SH			25 pF (f <sub>0</sub> ≤27 MHz/-40°C to +85°C)	4.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS=Max.)	40 % to 60 % (50 % V <sub>CC</sub> , L_CMOS=15 pF, f <sub>0</sub> ≤125 MHz/-20°C to +70°C)	ST
	PC	28 mA Max.	3.0 V to 3.6 V (2.7 V to 3.6 V)	15 pF (f <sub>0</sub> ≤66.7 MHz/2.7 to 3.6 V) 15 pF (f <sub>0</sub> ≤125 MHz/3.0 to 3.6 V)	3.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS=Max.)	45 % to 55 % (50 % V <sub>CC</sub> , L_CMOS=15 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>0</sub> ≤40 MHz) 40 % to 60 % (50 % V <sub>CC</sub> , L_CMOS=15 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>0</sub> ≤125 MHz) ↑ (50 % V <sub>CC</sub> , L_CMOS=15 pF, V <sub>CC</sub> =2.7 V to 3.6 V, f <sub>0</sub> ≤66.7 MHz)	OE	
				SC	4.0 ns Max. (20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L_CMOS=Max.)	ST		

## SG-8002 series and HG-8002 series

### ■ PLL-PLL connection

Because we use a PLL technology, there are a few cases that the jitter value will increase when SG-8002 is connected to another PLL-oscillator.

In our experience, we are unable to recommend these products for the applications such as telecom carrier use or analog video clock use. Please be careful checking in advance for these application (Jitter specification is Max.250 ps/CL=15 pF)

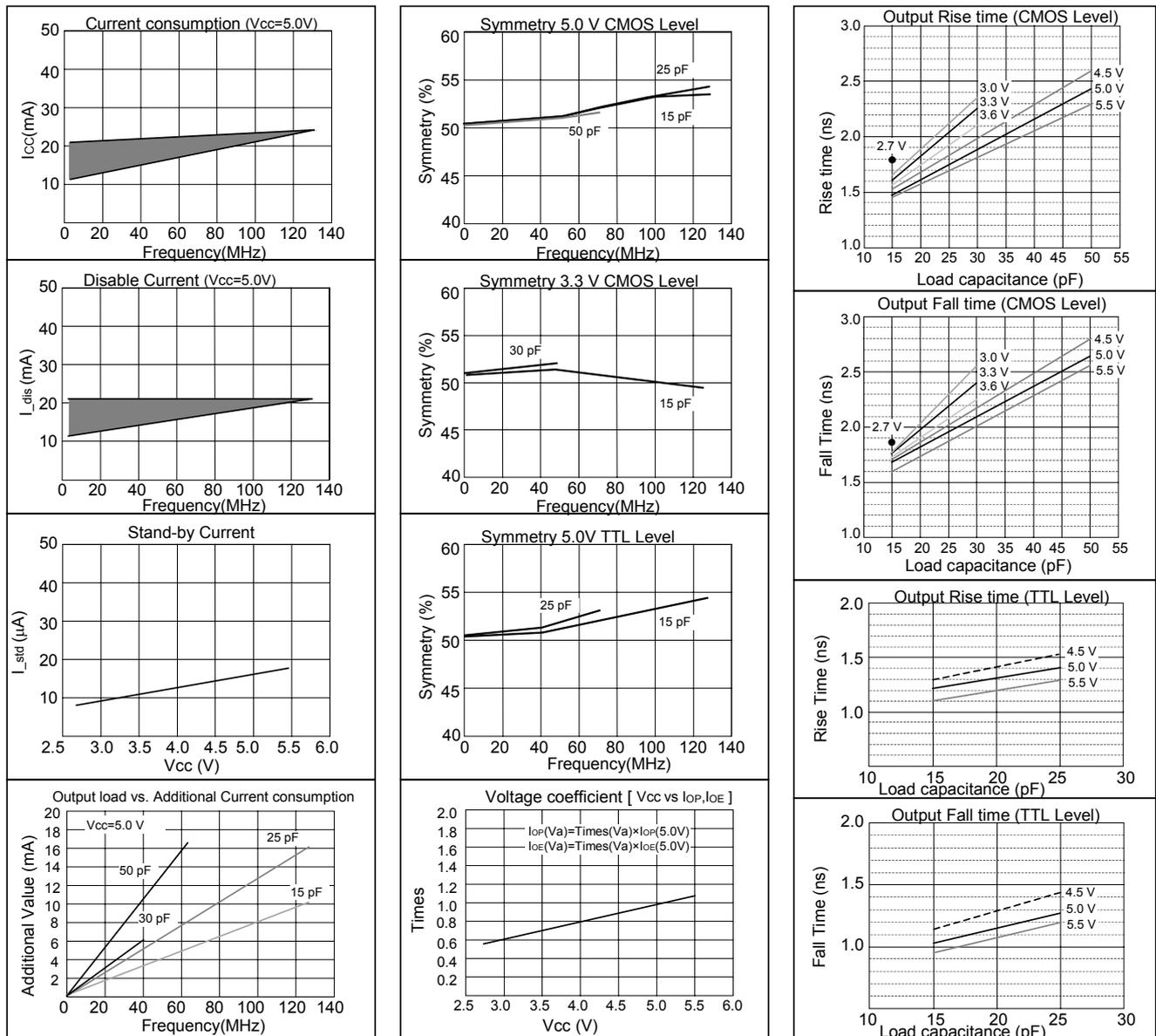
### ■ Remarks on noise management for power supply line

We do not recommend inserting filters or other devices in the power supply line as the counter measure of EMI noise reduction. This device insertion might cause high-frequency impedance high in the power supply line and it affects oscillator stable drive. When this measure is required, please evaluate circuitry and device behavior in the circuit and verify that it will not affect oscillation. Start up time (0 % Vcc to 90 % Vcc) of power source should be more than 150  $\mu$ s.

### ■ Jitter Specifications

Model	Supply Voltage	Jitter Item	Specifications	Remarks
PT / PH ST / SH	5 V $\pm$ 0.5 V	Cycle to cycle	150 ps Max.	33 MHz $\leq$ f <sub>0</sub> $\leq$ 125 MHz, L <sub>CMOS</sub> =15 pF
			200 ps Max.	1.0 MHz $\leq$ f <sub>0</sub> < 33 MHz, L <sub>CMOS</sub> =15 pF
		Peak to peak	200 ps Max.	33 MHz $\leq$ f <sub>0</sub> $\leq$ 125 MHz, L <sub>CMOS</sub> =15 pF
			250 ps Max.	1.0 MHz $\leq$ f <sub>0</sub> < 33 MHz, L <sub>CMOS</sub> =15 pF
SC / PC	3.3 V $\pm$ 0.3 V	Cycle to cycle	200 ps Max.	1.0 MHz $\leq$ f <sub>0</sub> $\leq$ 125 MHz, L <sub>CMOS</sub> =15 pF
		Peak to peak	250 ps Max.	1.0 MHz $\leq$ f <sub>0</sub> $\leq$ 125 MHz, L <sub>CMOS</sub> =15 pF

### ■ SG-8002 series Characteristics chart



## PROGRAMMING TOOL FOR SG-8002 SERIES

# SG-WRITER

- Easy frequency program for EPSON TOYOCOM SG-8002 series oscillator (Blank oscillator).
- Free power supply for USB accommodate.
- Flexible PC accommodate.  
Windows98SE, 2000, Me, XP (Except Windows 95, NT)
- Small body and easy carry.



### Main Body Specifications

Name	SG-Writer for EPSON TOYOCOM SG-8002 Series
Operating Temperature	+10 °C to +40 °C Writing (+25 °C ±5 °C)
Electric Power Supply	Via USB
Standard Interface	USB Type B
External Dimensions (mm)	160 × 110 × 36 (textool top)
Weight	700 g
Accessories	SG-Writer CD-ROM (Software and Instruction manual : Japanese, English) Documents : Japanese, English
Software, Driver	SG-Writer *1 EPSON USB Driver
Option	SMD socket (JA, JC, CA, JF, CE, LA, LB type)

\*1 SG-Writer software is available only from EPSON TOYOCOM website after user registration.

### Recommend PC Specifications (You need to connect the SG-Writer to a PC when you are writing.)

Accommodate OS	Windows XP, Windows Me, Windows 2000, Windows 98SE(Except Windows 95, NT)
Recommend CPU	Pentium Processor 200 MHz equivalent and higher (Recommend Over 300 MHz)
Recommend memory Capacity	Recommend Over 64 MB
Recommend HDD Capacity	Need Over 40 MB
Other	CD-ROM drive, USB cable (Type A ↔ Type B) Need SMD *2 socket when you write SG-8002 SMD products. (Sold individually)

\*2 Conventional SMD socket can be used with new SG-Writer.

**CRYSTAL OSCILLATOR  
SPREAD SPECTRUM**

**SG - 9001LB / CA / JC Series**

- Frequency range : 10 MHz to 166 MHz
- Supply voltage : 3.3 V
- Function : Output enable(OE)
- Thickness : 1.15 mm Typ.(SG-9001LB)  
1.40 mm Typ.(SG-9001CA)
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive:SG-9001JC  
Lead free completely:SG-9001 CA / LB
- Range of spreading percentage is selectable by program (Center or Down spread, 6 Values )



Actual size



**Specifications (characteristics)**

Item	Symbol	Specifications	Remarks
Output frequency range	$f_o$	10.000 MHz to 166.000 MHz	SG-9001JC,CA Please contact us for inquiries regarding available frequencies.
Supply voltage	$V_{cc}$	3.3 V $\pm$ 0.3 V	SG-9001LB
Temperature range	Storage temperature	-55 °C to +100 °C	SG-9001JC
	Operating temperature	-40 °C to +125 °C	SG-9001LB,CA
Current consumption	$I_{cc}$	30 mA Max.	No load condition, $f_o = 166$ MHz
Output disable current	$I_{dis}$	20 mA Max.	OE=GND, $f_o = 166$ MHz
Symmetry	SYM	45 % to 55 %	CMOS load: 50 % $V_{cc}$ level, $L_{CMOS}=15$ pF
High output voltage	$V_{OH}$	$V_{cc}-0.4$ V Min.	$I_{OH}=-8$ mA
Low output voltage	$V_{OL}$	0.4 V Max.	$I_{OL}= 8$ mA
Output load condition	$L_{CMOS}$	15 pF Max.	
Output enable / disable input voltage	$V_{IH}$	70 % $V_{cc}$ Min.	OE terminal
	$V_{IL}$	30 % $V_{cc}$ Max.	OE terminal
Output rise and fall time	$t_r / t_f$	2.7 ns Max.	20 % $V_{cc}$ to 80 % $V_{cc}$ level, $L_{CMOS}=15$ pF.
Oscillation start up time	$t_{osc}$	10 ms Max.	Time at minimum supply voltage to be 0 s
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, First year

**Spread Spectrum Specifications**

Center Spread	Code	C02P	C05P	C07P	C10P	C15P	C20P
	Percentage		$\pm 0.25$ %	$\pm 0.5$ %	$\pm 0.75$ %	$\pm 1.0$ %	$\pm 1.5$ %
Down Spread	Code	D05P	D10P	D15P	D20P	D30P	D40P
	Percentage		-0.5 %	-1.0 %	-1.5 %	-2.0 %	-3.0 %

**External dimensions**

(Unit:mm)

**●SG-9001LB**

Note.  
OE pin  
OE pin = "H" or "open" : Specified frequency output.  
OE pin = "L" : Output disable output is weak pull-down. (130 k $\Omega$  Typ.)  
SSON pin (SG-9001CA)  
SSON pin = "H" : Spread spectrum disable.  
SSON pin = "L" or "open" : Spread spectrum enable.

**●SG-9001CA**

**●SG-9001JC**

Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

**Footprint (Recommended)**

(Unit:mm)

**●SG-9001LB**

**●SG-9001CA**

**●SG-9001JC**

**CRYSTAL OSCILLATOR  
LOW-JITTER SAW OSCILLATOR**

**XG - 1000CA / CB Series**

- Output frequency range : 50 MHz to 170 MHz
- Supply voltage : 1.8V / 2.5V / 3.3V
- Frequency stability :  $\pm 50 \times 10^{-6}$ ,  $\pm 100 \times 10^{-6}$
- Output : CMOS
- Function : Output enable(OE)
- Package size : CA:7.0x5.0x1.2 mm Typ.  
CB:5.0x3.2x1.1 mm Typ.
- Lead(Pb)-free : Lead free completely
- Low-jitter oscillator with SAW.



Actual size

XG-1000CA

XG-1000CB



**Specifications (characteristics)**

Item	Symbol	Specifications			Remarks
		E	D	C	
Output frequency range *1	$f_0$	50.000 MHz to 170.000 MHz 75.000 MHz, 98.304 MHz, 100.000 MHz, 106.250 MHz, 125.000 MHz, 150.000 MHz			Standard frequency
Supply voltage	V <sub>cc</sub>	1.8 V $\pm$ 0.1V	2.5 V $\pm$ 0.125 V	3.3 V $\pm$ 0.3V	
Temperature range	T <sub>stg</sub> T <sub>use</sub>	-40 °C to +100 °C -10 °C to +70 °C			Stored as bare product after unpacking
Frequency tolerance *2	F <sub>tol(osc)</sub>	B: $\pm 50 \times 10^{-6}$ C: $\pm 100 \times 10^{-6}$			-10 °C to +70 °C
Current consumption	I <sub>cc</sub>	20 mA Max.	25 mA Max.	35 mA Max.	No load condition, OE=V <sub>cc</sub>
Output disable current	I <sub>dis</sub>	15 mA Max.	20 mA Max.	30 mA Max.	OE=GND
Symmetry	SYM	40 % to 60 %			CMOS load: 50 % V <sub>cc</sub> level, Max. load condition
High output voltage	V <sub>OH</sub>	V <sub>cc</sub> -0.35 V Min			E: I <sub>OH</sub> = -6 mA / C, D: I <sub>OH</sub> = -8 mA
Low output voltage	V <sub>OL</sub>	0.35 V Max.			E: I <sub>OL</sub> = 6 mA / C, D: I <sub>OL</sub> = 8 mA
Output load condition (CMOS)	L <sub>CMOS</sub>	15 pF Max.			Max. frequency and Max. supply voltage range
Output enable/ Disable input voltage	V <sub>IH</sub> V <sub>IL</sub>	70 % V <sub>cc</sub> Min. 30 % V <sub>cc</sub> Max.			OE terminal
Output rise and fall time	t <sub>r</sub> / t <sub>f</sub>	2 ns Max.			CMOS load : 20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level
Oscillation start up time	t <sub>osc</sub>	10 ms Max.			Time at minimum supply voltage to be 0 s
Jitter *3	t <sub>RMS</sub> t <sub>p-p</sub>	3 ps Typ. 25 ps Typ.			$\sigma$ (RMS of total distribution) Peak to Peak
Frequency aging	F <sub>aging</sub>	$\pm 5 \times 10^{-6}$ / year Max.			+25 °C, First year, V <sub>cc</sub> =1.8 V, 2.5 V, 3.3 V

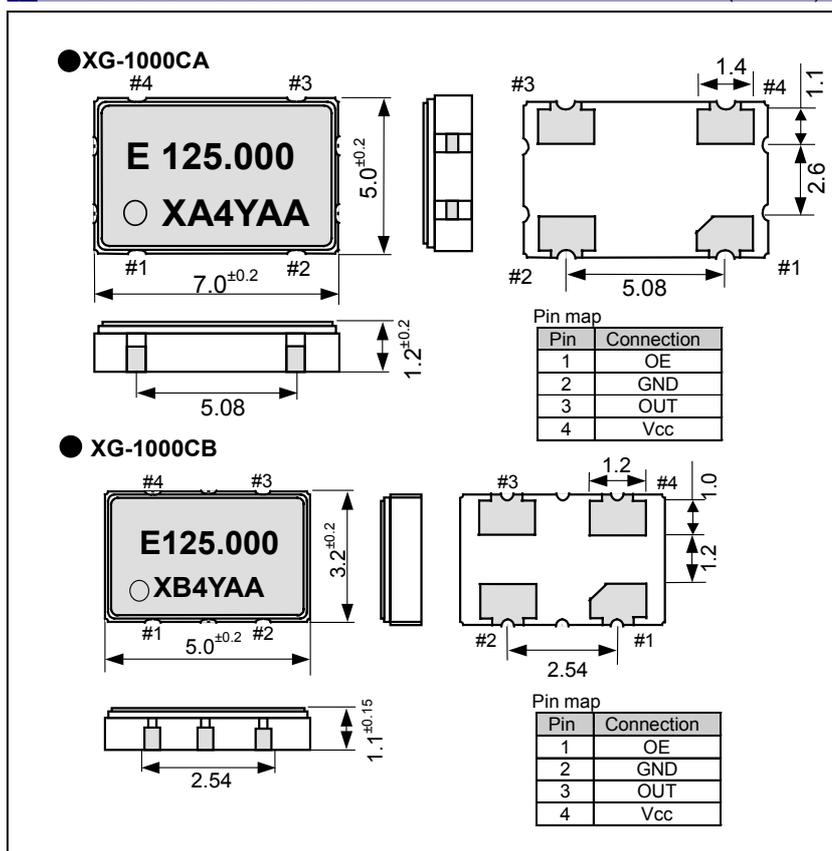
\*1 Please contact us for inquiries regarding non-standard frequencies.

\*2 This includes initial frequency tolerance, temperature variation, supply voltage variation and frequency tolerance vs. load.

\*3 Based on DTS-2075 Digital timing system made from WAVECREST with jitter analysis software VISI6.

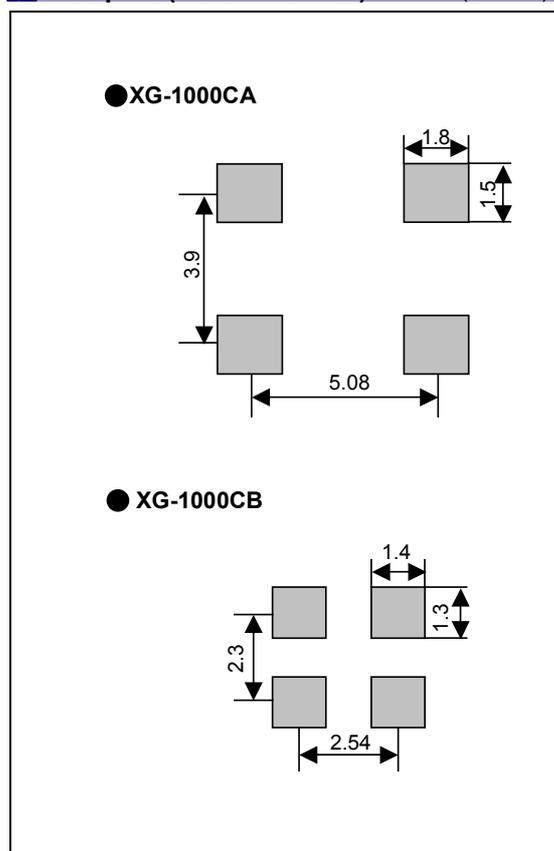
**External dimensions**

(Unit:mm)



**Footprint (Recommended)**

(Unit:mm)



## CRYSTAL OSCILLATOR LOW-JITTER SAW OSCILLATOR

### EG - 2021 / 2001CA Series

- Frequency range : 62.5 MHz to 170 MHz
- Supply voltage : 2.5V/ EG-2021CA  
3.3V/ EG-2001CA
- Output : CMOS
- Function : Output enable(OE)
- Thickness : 1.2 mm Typ.
- Lead(Pb)-free : Lead free completely
- Very low jitter and low phase noise by SAW unit.



Actual size

EG-2021

EG-2001



### Specifications (characteristics)

Item	Symbol	Specifications		Remarks
		EG-2021CA	EG-2001CA	
Output frequency range	$f_0$	62.500 MHz to 170.000 MHz	106.250 MHz to 170.000 MHz	
Supply voltage	$V_{CC}$	2.5 V $\pm$ 0.125 V	3.3 V $\pm$ 0.3 V	
Temperature range	Storage temperature	-40 °C to +100 °C		Stored as bare product after unpacking
	Operating temperature	P: 0 °C to +70 °C R: -5 °C to +85 °C	P: 0 °C to +70 °C	
Frequency tolerance	$F_{tol}(osc)$	G: $\pm 50 \times 10^{-6}$ , H: $\pm 100 \times 10^{-6}$	Z: $\pm 50 \times 10^{-6}$ , Y,H: $\pm 100 \times 10^{-6}$	P: 0 °C to 70 °C, R: -5 °C to +85 °C *1
Current consumption	$I_{CC}$	25 mA Max.	50 mA Max.	No load condition, Max. frequency range
Output disable current	$I_{dis}$	600 $\mu$ A Max.	10 $\mu$ A Max.	OE=GND
Symmetry	SYM	40 % to 60 %	45 % to 55 %	CMOS load: 50 % $V_{CC}$ level, $L_{CMOS}$ = Max.
High output voltage	$V_{OH}$	$V_{CC}$ -0.35 V Min.	$V_{CC}$ -0.4 V Min.	$I_{OH}$ = -8 mA
Low output voltage	$V_{OL}$	0.35 V Max.	0.4 V Max.	$I_{OL}$ = 8 mA
Output load condition	$L_{CMOS}$	15 pF Max.		Max. frequency and Max. supply voltage range
High input voltage	$V_{IH}$	70 % $V_{CC}$ Min.		OE terminal
Low input voltage	$V_{IL}$	30 % $V_{CC}$ Max.		OE terminal
Output rise and fall time	$t_r / t_f$	2 ns Max.		CMOS load: 20 % $V_{CC}$ to 80 % $V_{CC}$ level
Oscillation start up time	$t_{osc}$	10 ms Max.		Time at minimum supply voltage to be 0 s
Jitter *2	$t_{DJ}$	0.2 ps Typ.		Deterministic Jitter
	$t_{RJ}$	3 ps Typ.		Random Jitter
	$t_{RMS}$	3 ps Typ.		$\sigma$ (RMS of total distribution)
	$t_{p-p}$	25 ps Typ.		Peak to Peak
	$t_{acc}$	4 ps Typ.		Accumulated Jitter( $\sigma$ ) n=2 to 50000 cycles
Phase Jitter	$t_{PJ}$	0.05 $\times 10^{-3}$ UI Typ. 1 ps Max.		Offset frequency: 12 kHz to 20 MHz
Frequency aging*3	$F_{aging}$	$\pm 10 \times 10^{-6}$ / year Max.	$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, First year, $V_{CC}$ =2.5 V, 3.3 V

\*1 As per below table

\*2 Based on DTS-2075 Digital timing system made from WAVECREST with jitter analysis software VISI6.

\*3 Except: CHPA, CHRA, PCH

Model	EG-2021CA		
	Details of frequency tolerance	A *4	N *5
Frequency tolerance	HP: $\pm 100 \times 10^{-6}$ (0°C to +70°C)	CHPA	CHPN
	HR: $\pm 100 \times 10^{-6}$ (-5°C to +85°C)	CHRA	CHRN
	GP: $\pm 50 \times 10^{-6}$ (0°C to +70°C)	—	CGPN
	GR: $\pm 50 \times 10^{-6}$ (-5°C to +85°C)	—	CGRN*7

Model	EG-2001CA	
	Output mode	P: Symmetry 50 $\pm$ 5 %
Frequency tolerance	H: $\pm 100 \times 10^{-6}$ (0°C to +70°C) *4	PCH
	Y: $\pm 100 \times 10^{-6}$ (0°C to +70°C) *5	PCY
	Z: $\pm 50 \times 10^{-6}$ (0°C to +70°C) *6	PCZ

\*4 This includes initial frequency tolerance, temperature variation, supply voltage variation, load variation, reflow drift, and aging(+25 °C, 10 years).

\*5 This includes initial frequency tolerance, temperature variation, supply voltage variation, load variation, and reflow drift.(except aging)

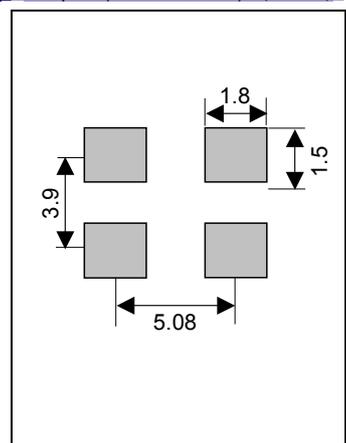
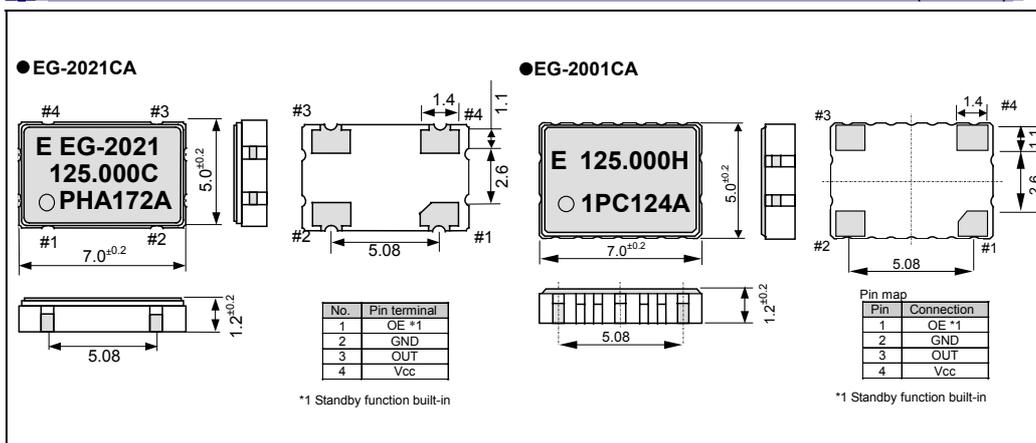
\*6 This includes initial frequency tolerance, and temperature variation.(except reflow drift, supply voltage variation, load variation and aging)

\*7 Please contact us for inquiries.

### External dimensions

(Unit:mm)

Footprint (Recommended) (unit:mm)



**CRYSTAL OSCILLATOR  
LOW-JITTER SAW OSCILLATOR**

**EG - 2002CA**

- Frequency range : 62.5 MHz to 170 MHz
- Operating voltage : 3.3 V
- Output : LV-TTL
- Function : Output enable(OE)
- Thickness : 1.2 mm Typ.
- Lead(Pb)-free : Lead free completely
- Very low jitter and low phase noise by SAW unit.



Actual size



**Specifications (characteristics)**

Item	Symbol	Specifications	Remarks
Output frequency range	f <sub>o</sub>	62.500 MHz to 170.000 MHz	Please contact us for inquiries regarding available frequencies.
Supply voltage	V <sub>cc</sub>	3.3 V ± 0.3 V	
Temperature range	Storage temperature	T <sub>stg</sub>	-40 °C to +100 °C
	Operating temperature	T <sub>use</sub>	0 °C to +70 °C
Frequency tolerance	F <sub>tol(osc)</sub>	±50 × 10 <sup>-6</sup> , ±100 × 10 <sup>-6</sup>	0 °C to +70 °C *1
Current consumption	I <sub>cc</sub>	60 mA Max.	OE=V <sub>cc</sub> , No load condition
Output disable current	I <sub>dis</sub>	25 mA Max.	OE=GND
Symmetry	SYM	45 % to 55 %	1.4 V level, L <sub>CMOS</sub> ≤ Max.
High output voltage	V <sub>OH</sub>	2.4 V Min.	I <sub>OH</sub> = -8 mA
Low output voltage	V <sub>OL</sub>	0.4 V Max.	I <sub>OL</sub> = 8 mA
Output load condition	L <sub>CMOS</sub>	25 pF Max.	f <sub>o</sub> = 62.5 MHz
		15 pF Max.	f <sub>o</sub> > 62.5 MHz
High input voltage	V <sub>IH</sub>	70 % V <sub>cc</sub> Min.	OE terminal
Low input voltage	V <sub>IL</sub>	30 % V <sub>cc</sub> Max.	OE terminal
Output rise and fall time	t <sub>r</sub> / t <sub>f</sub>	1.5 ns Max.	0.8 V → 2.0 V level, L <sub>CMOS</sub> ≤ Max.
Oscillation start up time	t <sub>osc</sub>	10 ms Max.	Time at minimum supply voltage to be 0 s
	t <sub>dj</sub>	0.2 ps Typ.	Deterministic Jitter
	t <sub>rj</sub>	3 ps Typ.	Random Jitter
	t <sub>rms</sub>	3 ps Typ.	σ (RMS of total distribution)
	t <sub>p-p</sub>	25 ps Typ.	Peak to Peak
	t <sub>acc</sub>	4 ps Typ.	Accumulated Jitter(σ) n=2 to 50000 cycles
Phase Jitter	t <sub>pj</sub>	0.05 × 10 <sup>-3</sup> UI Typ.	Offset frequency: 12 kHz to 20 MHz
		1 ps Max.	
Frequency aging *3	F <sub>aging</sub>	± 5 × 10 <sup>-6</sup> / year Max.	+25 °C, First year, V <sub>cc</sub> =3.3 V

\*1 As per below table

\*2 Based on DTS-2075 Digital timing system made from WAVECREST with jitter analysis software VISI6.

\*3 Except : PCH,DCH

	Frequency range (MHz)	P: 125 to 170	D: 62.5 to 124.999
Details of frequency tolerance	H: ±100×10 <sup>-6</sup> (0 °C to +70 °C)*4	PCH	DCH
	Y: ±100×10 <sup>-6</sup> (0 °C to +70 °C) *5	PCY	DCY
	Z: ±50×10 <sup>-6</sup> (0 °C to +70 °C)*6	PCZ	DCZ
	F: ±50×10 <sup>-6</sup> (0 °C to +70 °C)*5	PCF (125 MHz Only)	—

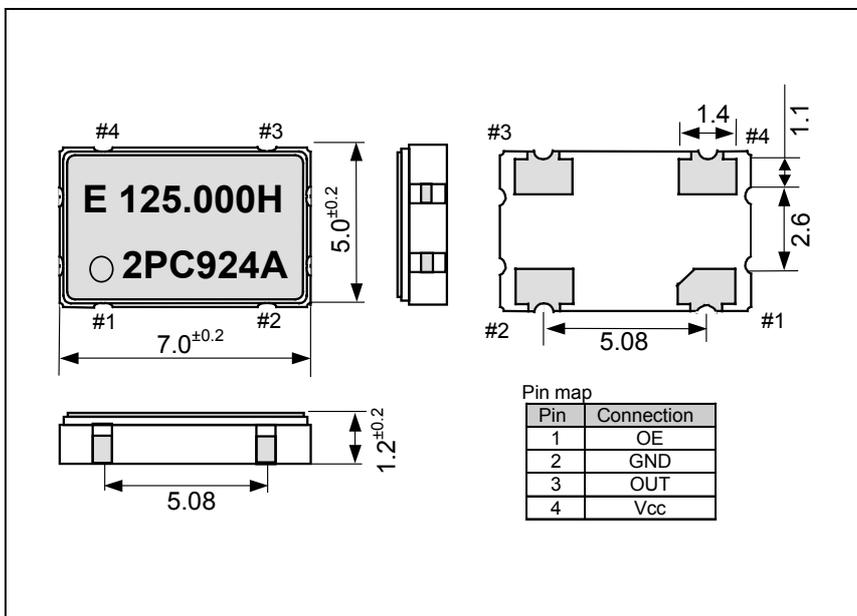
\*4 This includes initial frequency tolerance, temperature variation, supply voltage variation, load variation, reflow drift, and 10 years aging (+25 °C, 10 years).

\*5 This includes initial frequency tolerance, temperature variation, supply voltage variation, load variation, and reflow drift (except 10 years aging).

\*6 This includes initial frequency tolerance and temperature variation (except supply voltage variation, load variation, reflow drift, and 10 years aging).

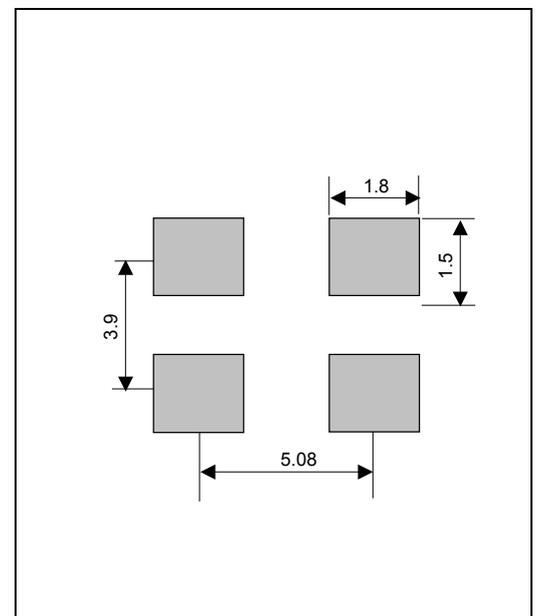
**External dimensions**

(Unit:mm)



**Footprint (Recommended)**

(Unit:mm)



## CRYSTAL OSCILLATOR

### LOW-JITTER SAW OSCILLATOR

# EG-2121 / 2102CA series

- Frequency range : 53.125 MHz to 700 MHz
- Supply voltage : 2.5 V (EG-2121CA)  
3.3 V (EG-2102CA)
- Output : Differential LV-PECL or LV-DS
- Function : Output enable(OE)
- Thickness : 1.2 mm Typ.
- Lead(Pb)-free : Lead free completely
- Very low jitter and low phase noise by SAW unit.



Actual size

EG-2121CA

EG-2102CA



### Specifications (characteristics)

Item	Symbol	Specifications				Remarks	
		EG-2121CA	EG-2102CA	EG-2121CA	EG-2102CA		
Output frequency range	$f_o$	Differential LV-PECL		LV-DS		Please contact us for inquiries regarding available frequencies.	
		53.125 MHz to 500 MHz	100 MHz to 700 MHz	53.125 MHz to 700 MHz			
Supply voltage	$V_{cc}$	2.5 V $\pm 0.125$ V	3.3 V $\pm 0.3$ V	2.5 V $\pm 0.125$ V	3.3 V $\pm 0.3$ V	Stored as bare product after unpacking	
Temperature range	$T_{stg}$ $T_{use}$	-40 °C to +100 °C P:0 °C to +70 °C, R:-5 °C to +85 °C					
Frequency tolerance	$F_{tol}(osc)$	G: $\pm 50 \times 10^{-6}$ , H: $\pm 100 \times 10^{-6}$				P:0 °C to +70 °C, R:-5 °C to +85 °C *1	
Current consumption	$I_{cc}$	80 mA Max.	100 mA Max.	30 mA Max	45 mA Max.	OE= $V_{cc}$ , RL=50 $\Omega$ or 100 $\Omega$	
Output disable current	$I_{dis}$	20 mA Max.	32 mA Max	20 mA Max	30 mA Max.	OE=GND	
Symmetry	SYM	P:45 % to 55 %	P:45 % to 55 %	L:45 % to 55 %	L:45 % to 55 %	$f_o=350$ MHz (at outputs crossing point) *1	
Output voltage	$V_{OH}$	1.55 V Typ.	2.35 V Typ.	—		DC characteristics	
	$V_{OL}$	0.8 V Typ.	1.6 V Typ.	—			
	$V_{OD}$	$V_{cc}-1.025$ to $V_{cc}-0.88$		—			
	$\Delta V_{OD}$	—		350 mV Typ. 247 mV to 454 mV			
	$V_{OS}$	—		1.25 V Typ. 1.125 V to 1.375 V			
Output load condition	$R_L$	50 $\Omega$		100 $\Omega$		LV-PECL: Terminated to $V_{cc}-2.0$ V LV-DS: Connected between OUT to $\overline{OUT}$	
	Output enable input voltage	$V_{IH}$	70 % $V_{cc}$ Min.				
	Output disable input voltage	$V_{IL}$	30 % $V_{cc}$ Max.				
Output rise and fall time	$t_r / t_f$	400 ps Max.				LV-PECL: 80 % to 20 % ( $V_{OH}-V_{OL}$ ) LV-DS: 80 % to 20 % ( $V_{OD} \times 2$ )	
Oscillation start up time	$t_{OSC}$	10 ms Max.				Time at minimum supply voltage to be 0 s	
Jitter *2	$t_{DJ}$	0.2 ps Typ.				Deterministic Jitter	
	$t_{RJ}$	3 ps Typ.				Random Jitter	
	$t_{RMS}$	3 ps Typ.				$\sigma$ (RMS of total distribution)	
	$t_{p-p}$	25 ps Typ.				Peak to Peak	
	$t_{acc}$	4 ps Typ.				Accumulated Jitter( $\sigma$ ) n=2 to 50000 cycles	
Phase Jitter	$t_{PJ}$	0.05 $\times 10^{-3}$ UI Typ. 1 ps Max.				Offset frequency: 12 kHz to 20 MHz	
Frequency aging *3	$F_{aging}$	$\pm 10 \times 10^{-6}$ / year Max.				+25 °C, First year, $V_{cc}=2.5$ V, 3.3 V	

\*1 As per below table.

\*2 Based on DTS-2075 Digital timing system made from WAVECREST with jitter analysis software VISI6.

\*3 Except: \*\*\*A

Output mode	P:Differential LV-PECL		D: Differential LV-PECL		L:LV-DS		V:LV-DS		
Frequency range	EG-2121CA	All range	$f_o \leq 175$ MHz		All range		$f_o \leq 175$ MHz		
	EG-2102CA		$f_o \leq 350$ MHz						
Symmetry	EG-2121CA	50 $\pm 10$ % ( $f_o > 350$ MHz)	50 $\pm 2$ %		50 $\pm 10$ % ( $f_o > 350$ MHz)		50 $\pm 2$ %		
	EG-2102CA	50 $\pm 5$ % ( $f_o \leq 350$ MHz)			50 $\pm 5$ % ( $f_o \leq 350$ MHz)				
Details of frequency tolerance		A *4	N *5	A *4	N *5	A *4	N *5	A *4	N *5
Frequency tolerance	HP: $\pm 100 \times 10^{-6}$ (0°C to +70°C)	PHPA	PHPN	DHPA	DHPN	LHPA	LHPN	VHPA	VHPN
	HR: $\pm 100 \times 10^{-6}$ (-5°C to +85°C)	PHRA*6	PHRN*6	DHRA*6	DHRN*6	LHRA*6	LHRN*6	VHRA*6	VHRN*6
	GP: $\pm 50 \times 10^{-6}$ (0°C to +70°C)	PGPA*6	PGPN*6	DGPA*6	DGPN*6	LGPA*6	LGPN*6	VGPA*6	VGPN*6
	GR: $\pm 50 \times 10^{-6}$ (-5°C to +85°C)	—	PGRN*6	—	DGRN*6	—	LGRN*6	—	VGRN*6

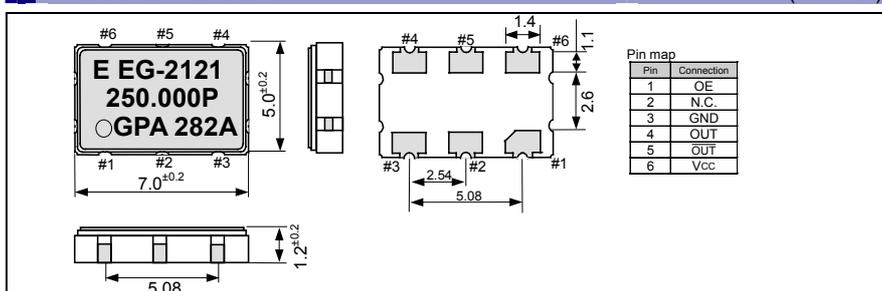
\*4 This includes initial frequency tolerance, temperature variation, supply voltage variation, reflow drift, and aging(+25 °C, 10 years).

\*5 This includes initial frequency tolerance, temperature variation, supply voltage variation, and reflow drift(except aging).

\*6 53.125 MHz  $\leq f_o < 100$  MHz : Unavailable.

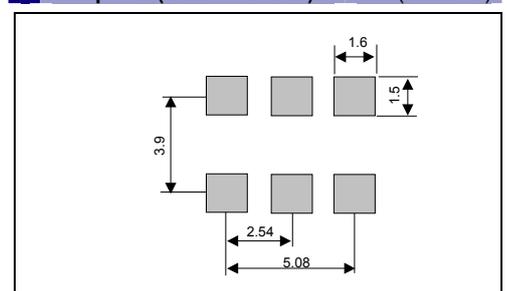
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



**CRYSTAL OSCILLATOR  
LOW-JITTER SAW OSCILLATOR**

**EG-2101CA**

- Frequency range : 62.5 MHz to 400 MHz
- Supply voltage : 3.3 V
- Output : Differential LV-PECL
- Function : Output enable(OE)
- Thickness : 1.2 mm Typ.
- Lead(Pb)-free : Lead free completely
- Very low jitter and low phase noise by SAW unit.



Actual size



**Specifications (characteristics)**

Item	Symbol	Specifications	Remarks
Output frequency range	f <sub>o</sub>	62.500 MHz to 400.000 MHz	Please contact us for inquiries regarding available frequencies
Supply voltage	V <sub>cc</sub>	3.3 V ±0.15 V	
Temperature range	Storage temperature	T <sub>stg</sub>	-40 °C to +100 °C
	Operating temperature	T <sub>use</sub>	0 °C to +70 °C
Frequency tolerance	F <sub>tol(osc)</sub>	±50 × 10 <sup>-6</sup> , ±100 × 10 <sup>-6</sup>	0 °C to +70 °C *1
Current consumption	I <sub>cc</sub>	60 mA Max.	OE=V <sub>cc</sub> , R <sub>L</sub> =50 Ω
Output disable current	I <sub>OE</sub>	25 mA Max.	OE=GND
Symmetry *3	SYM	P:45 % to 55 %	PCH,PCY,PCZ DCH,DCY,DCZ
		D:47.5 % to 52.5 %	
High output voltage	V <sub>OH</sub>	2.35 V Typ. V <sub>cc</sub> -1.025 to V <sub>cc</sub> -0.88	DC characteristics
Low output voltage	V <sub>OL</sub>	1.60 V Typ. V <sub>cc</sub> -1.81 to V <sub>cc</sub> -1.62	
Output load condition	R <sub>L</sub>	50 Ω	Terminated to V <sub>cc</sub> -2.0 V
High input voltage	V <sub>IH</sub>	70 % V <sub>cc</sub> Min.	OE terminal
Low input voltage	V <sub>IL</sub>	30 % V <sub>cc</sub> Max.	OE terminal
Output rise and fall time	t <sub>r</sub> / t <sub>f</sub>	600 ps Max.	20 % to 80 % (V <sub>OH</sub> -V <sub>OL</sub> )
Oscillation start up time	t <sub>osc</sub>	10 ms Max.	Time at minimum supply voltage to be 0 s
Jitter *2	t <sub>dj</sub>	0.2 ps Typ.	Deterministic Jitter
	t <sub>rj</sub>	3 ps Typ.	Random Jitter
	t <sub>rms</sub>	3 ps Typ.	σ (RMS of total distribution)
	t <sub>p-p</sub>	25 ps Typ.	Peak to Peak
	t <sub>acc</sub>	4 ps Typ.	Accumulated Jitter(σ) n=2 to 50000 cycles
Phase Jitter	t <sub>pj</sub>	0.05 × 10 <sup>-3</sup> UI Typ.	Offset frequency: 12 kHz to 20 MHz
		1 ps Max.	
Frequency aging *3	F <sub>aging</sub>	± 5 × 10 <sup>-6</sup> / year Max.	+25 °C, First year, V <sub>cc</sub> =3.3 V

\*1 As per below table

\*2 Based on DTS-2075 Digital timing system made from WAVECREST with jitter analysis software VISI6.

\*3 Except : PCH,DCH

Output mode (Symmetry)		P:Symmetry 50 ±5 %		D:Symmetry 50 ±2.5 %	
Frequency range (MHz)		125 to 318.75	318.751 to 400	62.5 to 159.375	159.376 to 200
Details of frequency tolerance	H: ±100 × 10 <sup>-6</sup> (0 °C to +70 °C)*4	PCH	—	DCH	—
	Y: ±100 × 10 <sup>-6</sup> (0 °C to +70 °C)*5	PCY	PCY	DCY	DCY
	Z: ±50 × 10 <sup>-6</sup> (0 °C to +70 °C)*6	PCZ	—	DCZ	—

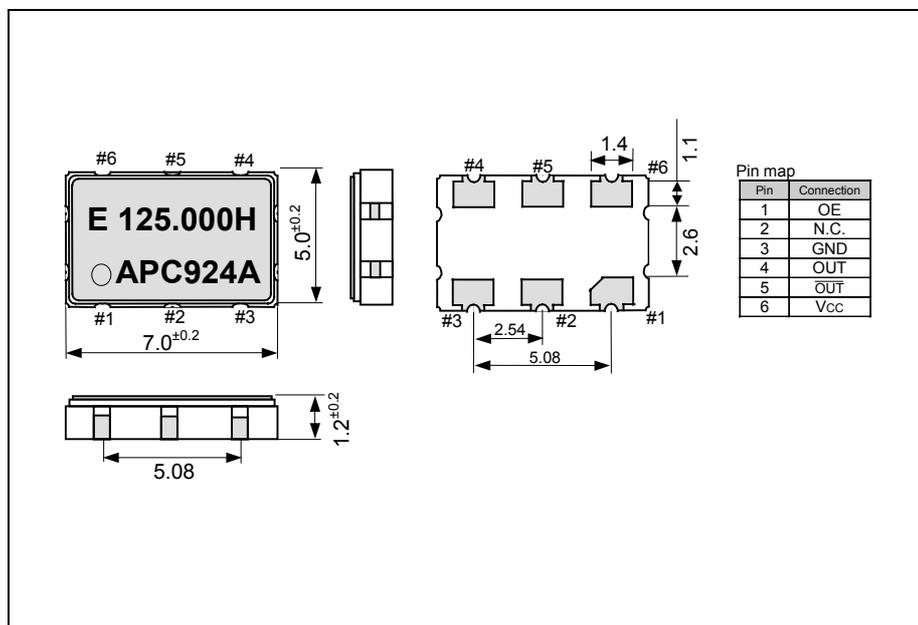
\*4 This includes initial frequency tolerance, temperature variation, supply voltage variation, reflow drift, and aging(+25 °C, 10 years).

\*5 This includes initial frequency tolerance, temperature variation, supply voltage variation, and reflow drift(except aging).

\*6 This includes initial frequency tolerance and temperature variation(except supply voltage variation, reflow drift, aging).

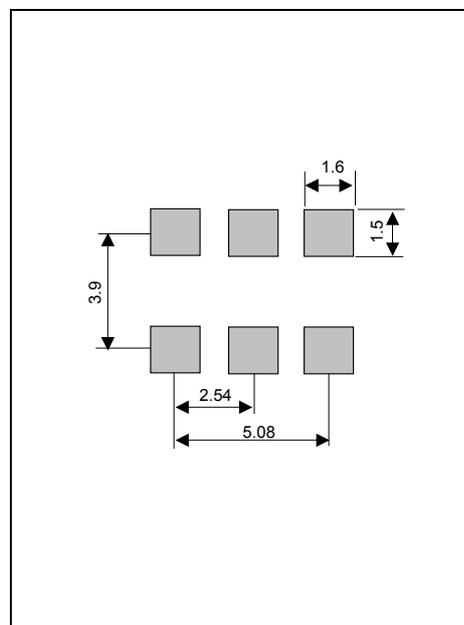
**External dimensions**

(Unit:mm)



**Footprint (Recommended)**

(Unit:mm)



## CRYSTAL OSCILLATOR HIGH-STABILITY

# HG - 2150CA series

- Frequency range : 1 MHz to 80 MHz
- Supply voltage : 3.3 V or 5.0 V
- Frequency stability :  $\pm 15 \times 10^{-6}$  / -20 °C to +70 °C
- Function : Output enable(OE)
- Thickness : 1.5 mm Max.
- Lead(Pb)-free : Lead free completely



Actual size



### Specifications (characteristics)

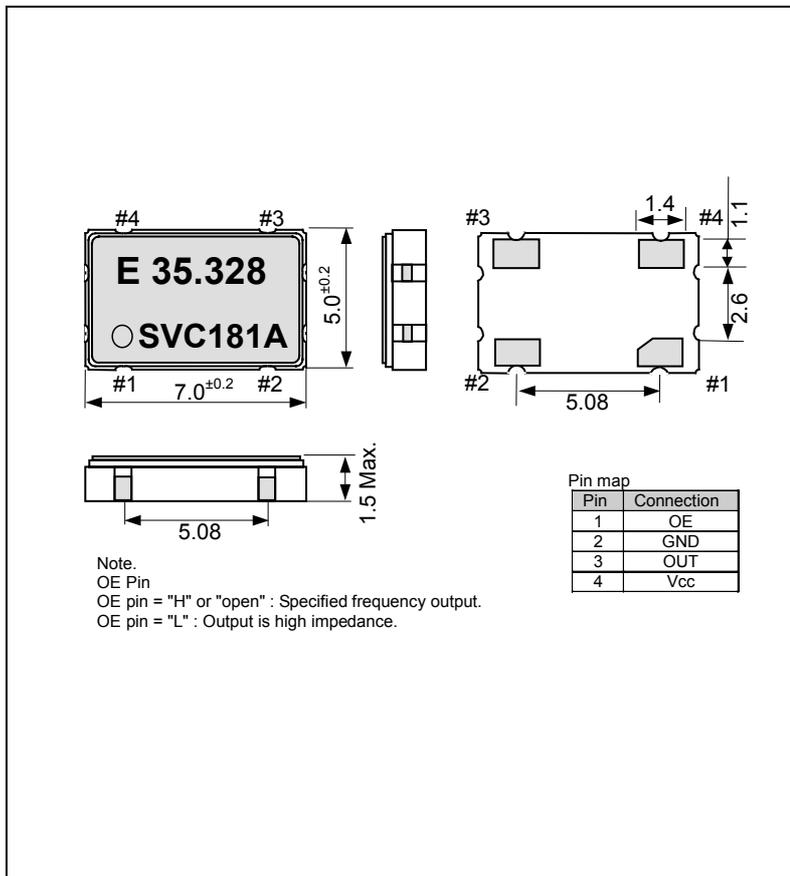
Item	Symbol	Specifications		Remarks
		SVH / BXH	SVC / BXC	
Output frequency range	$f_o$	1.000 MHz to 80.000 MHz		60 MHz < $f_o$ ≤ 80 MHz Please contact us for inquiries
Supply voltage	V <sub>CC</sub>	H:5.0 V ±0.5 V	C:3.3 V ±0.3 V	
Temperature range	Storage temperature	-40 °C to +125 °C		Stored as bare product after unpacking
	Operating temperature	V:-20 °C to +70 °C X:-40 °C to +85 °C		
Frequency tolerance	F <sub>tol</sub> (osc)	S: $\pm 15 \times 10^{-6}$ *1		-20 °C to +70 °C
		B: $\pm 25 \times 10^{-6}$ *1		-40 °C to +85 °C
Current consumption	I <sub>CC</sub>	30 mA Max.	25 mA Max.	No load condition, OE = V <sub>CC</sub>
Output disable current	I <sub>dis</sub>	15 mA Max.	12 mA Max.	OE=GND
Symmetry	SYM	45 % to 55 %		50 % V <sub>CC</sub> level
High output voltage	V <sub>OH</sub>	V <sub>CC</sub> -0.4 V Min.		I <sub>OH</sub> =4 mA
Low output voltage	V <sub>OL</sub>	0.4 V Max.		I <sub>OL</sub> = 4 mA
Output load condition	L <sub>CMOS</sub>	15 pF Max.		CMOS load
Output enable input voltage	V <sub>IH</sub>	70 % V <sub>CC</sub> Min.		OE terminal
Output disable input voltage	V <sub>IL</sub>	30 % V <sub>CC</sub> Max.		OE terminal
Output rise and fall time	tr / tf	4 ns Max.		20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> level
Oscillation start up time	t <sub>osc</sub>	10 ms Max.		Time at minimum supply voltage to be 0 s.
Frequency aging	F <sub>aging</sub>	$\pm 10 \times 10^{-6}$ Max. *2		+25 °C, 10 years

\*1 Frequency tolerance includes variation in reflow soldering drift, operating temperature range, supply voltage range and load change.

\*2 50 MHz <  $f_o$  ≤ 80 MHz:  $\pm 15 \times 10^{-6}$  Max.

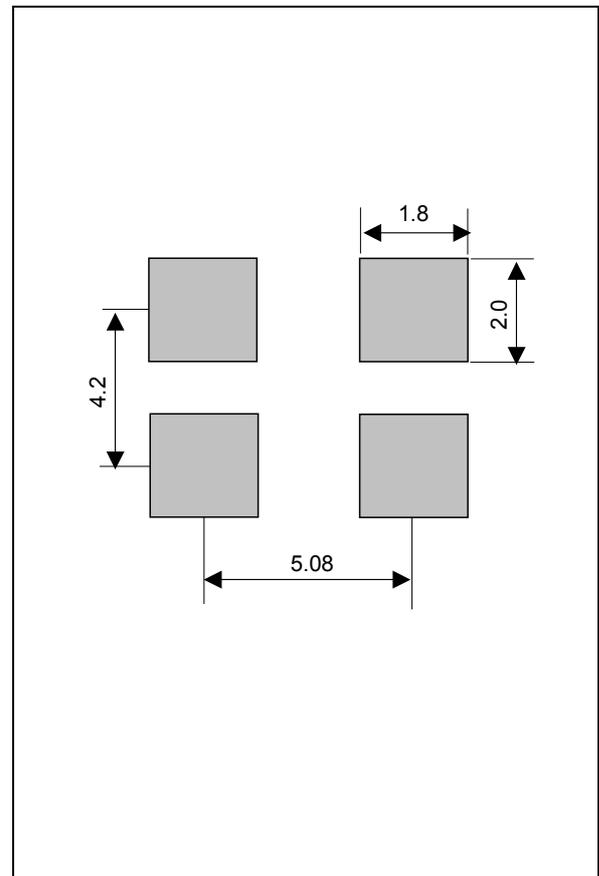
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



## CRYSTAL OSCILLATOR HIGH-STABILITY

# HG - 8002JA series

- Frequency range : 1 MHz to 125 MHz
- Supply voltage : 3.3 V or 5.0 V
- Frequency stability :  $\pm 20 \times 10^{-6}$  / -20 °C to +70 °C
- Function : Output enable(OE) or Standby( $\overline{ST}$ )
- Thickness : 4.7 mm Max.  
Package and pin compatible with SG-615.
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.



Actual size

EPSON AV  
100.0000  
HPH 9357B

### Specifications (characteristics)

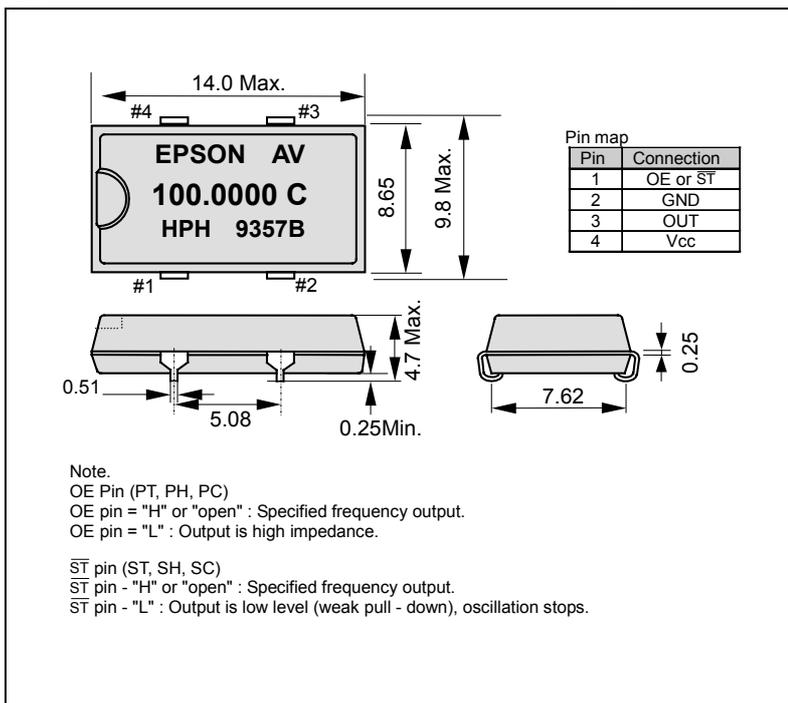
Item	Symbol	Specifications			Remarks
		PT / ST	PH / SH	PC / SC	
Output frequency range	$f_0$	1.000 MHz to 125.000 MHz			
Supply voltage	$V_{CC}$	5.0 V $\pm$ 0.25 V		3.3 V $\pm$ 0.165 V	
Temperature range	Storage temperature	$T_{stg}$ -55 °C to +125 °C			Stored as bare product after unpacking
	Operating temperature	$T_{use}$ -20 °C to +70 °C (-40 °C to +85 °C)		-40 °C to +85 °C	
Frequency tolerance	$F_{tol(osc)}$	AV: $\pm 20 \times 10^{-6}$ , BV: $\pm 25 \times 10^{-6}$ CX: $\pm 30 \times 10^{-6}$			-20 °C to +70 °C -40 °C to +85 °C *1
Current consumption	$I_{CC}$	45 mA Max.		28 mA Max.	No load condition, Max. frequency
Output disable current	$I_{dis}$	30 mA Max.		16 mA Max.	OE=GND (PT,PH,PC)
Stand-by current	$I_{std}$	50 $\mu$ A Max.			$\overline{ST}$ =GND (ST,SH,SC)
Symmetry	SYM	—		40 % to 60 %	CMOS load: 50% $V_{CC}$ level, Max. load condition
		40 % to 60 %		—	TTL load: 1.4V level, Max. load condition
High output voltage	$V_{OH}$	$V_{CC}$ -0.4 V Min.			$I_{OH}$ =-16 mA(PT,ST,PH,SH), -8 mA(PC,SC)
Low output voltage	$V_{OL}$	0.4 V Max.			$I_{OL}$ = 16 mA(PT,ST,PH,SH), 8 mA(PC,SC)
Output load condition (TTL)	$L_{TTL}$	2 TTL Max.		—	Max. frequency
Output load condition (CMOS)	$L_{CMOS}$	15 pF Max.			Max. supply voltage
Output enable / disable input voltage	$V_{IH}$	2.0 V Min.		70 % $V_{CC}$ Min.	$\overline{ST}$ , OE terminal
	$V_{IL}$	0.8 V Max.		20 % $V_{CC}$ Max.	$\overline{ST}$ , OE terminal
Output rise and fall time	$t_r / t_f$	—		3 ns Max.	CMOS load: 20 % $V_{CC}$ to 80 % $V_{CC}$ level
		4 ns Max.		—	TTL load: 0.4 V to 2.4 V level
Oscillation start up time	$t_{osc}$	10 ms Max.			Time at minimum supply voltage to be 0 s
Frequency aging	$F_{aging}$	$\pm 2 \times 10^{-6}$ / year Max.			+25 °C, $V_{CC}$ =5.0 V / 3.3 V (PC / SC)

PLL-PLL connection & Jitter specification, please refer to Page 49.

\*1 PT, ST and PH, SH for "CX" tolerance will be available up to 55 MHz.

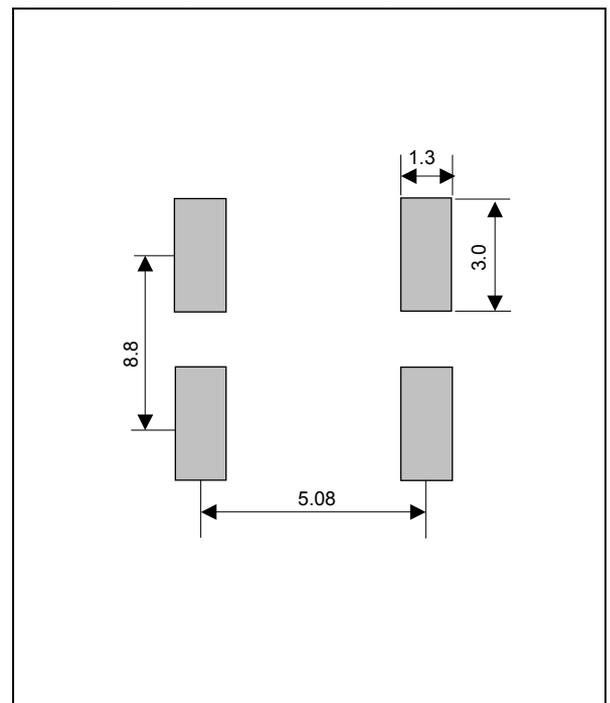
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



## CRYSTAL OSCILLATOR HIGH-STABILITY

# TCO-391B TCO-391C Series

- Frequency range : 8 MHz to 78 MHz
- Supply voltage : 3.3 V, 5.0 V
- Frequency stability :  $\pm 30 \times 10^{-6}$  / -20 °C to +70 °C
- Features : Fundamental mode oscillator with HFF-XTAL (fo  $\geq$  60MHz)
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



Actual size

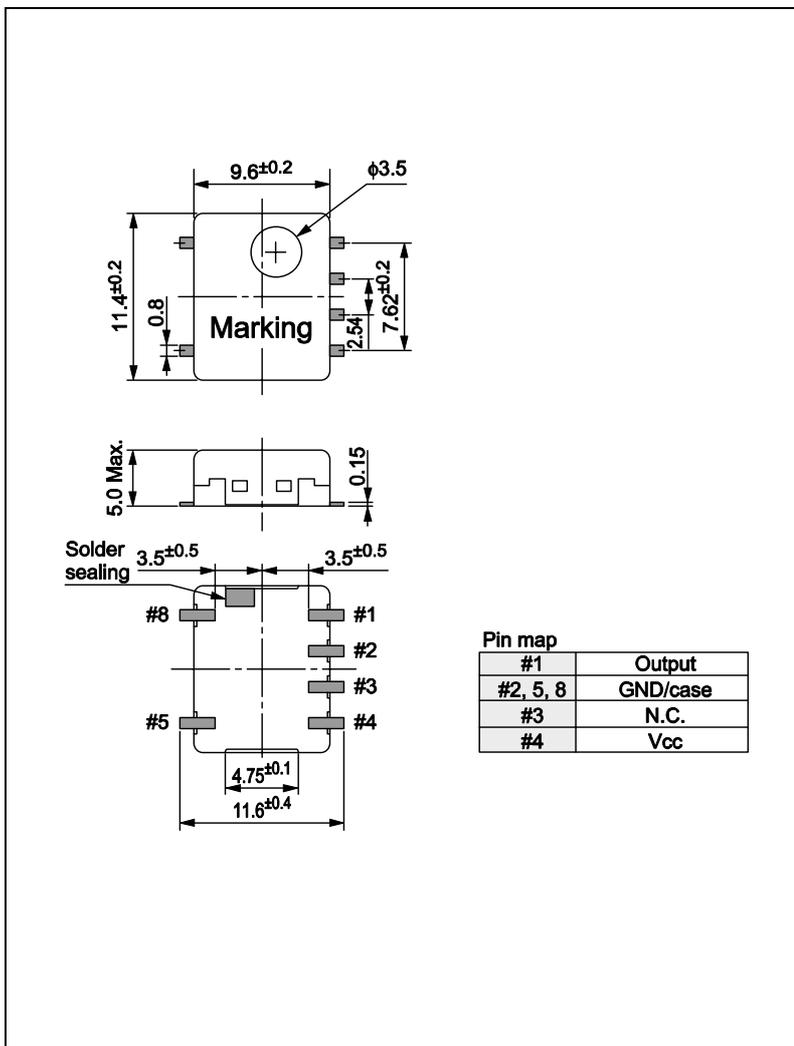


### Specifications (characteristics)

Item	Symbol	TCO-391B	TCO-391C	TCO-391C2	Remarks
Output frequency range		8.000 MHz to 78.000 MHz			
Standard frequency	f <sub>0</sub>	12.288 MHz, 16.384 MHz, 24.576 MHz, 32.768 MHz, 44.736 MHz, 51.840 MHz			Standard frequency
Supply voltage	V <sub>cc</sub>	5.0 V $\pm$ 0.25 V		3.3V $\pm$ 0.165 V	
Storage temperature range	T <sub>stg</sub>	-40 °C to +85 °C			
Operating temperature range	T <sub>use</sub>	-20 °C to +70 °C			
Frequency tolerance	F <sub>tol(osc)</sub>	$\pm 33 \times 10^{-6}$ Max.		$\pm 33 \times 10^{-6}$ Max.	-20 °C to +70 °C
Current consumption	I <sub>cc</sub>	30 mA Max.			
Output load condition (TTL)	L <sub>TTL</sub>	2 TTL Max.	—		
Output load condition (CMOS)	L <sub>CMOS</sub>	—	15 pF Max.		
Oscillation start up time	t <sub>osc</sub>	10 ms Max.			Time at minimum supply voltage to be 0 s.
Frequency aging	F <sub>aging</sub>	$\pm 3 \times 10^{-6}$ / year Max.			+25 °C, First year

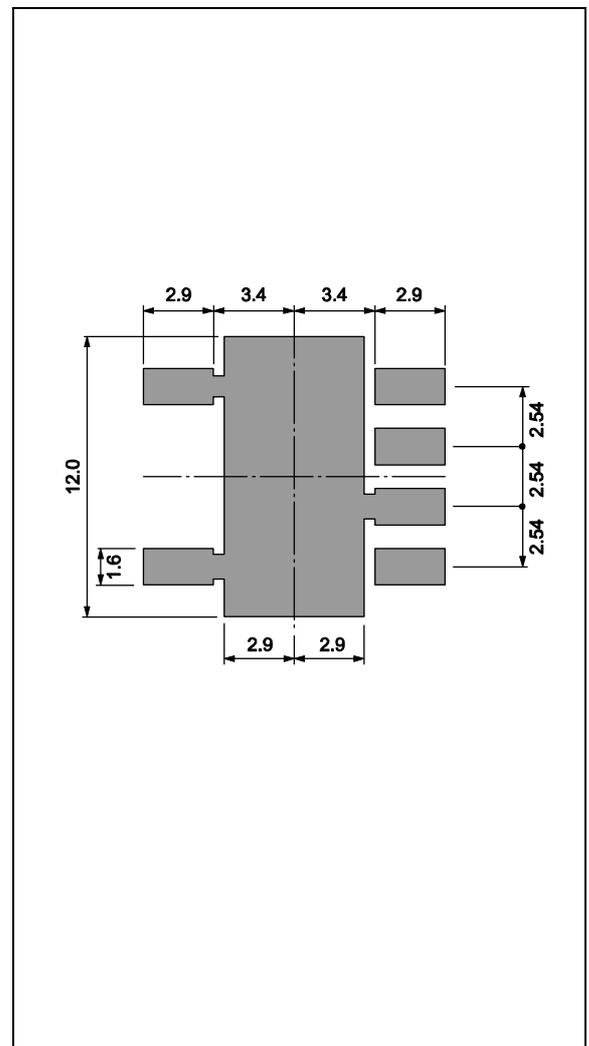
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



**CRYSTAL OSCILLATOR  
HIGH-STABILITY**

**TCO-393F**

- Frequency range : 100 MHz to 500 MHz
- Supply voltage : 3.3 V
- Frequency stability :  $\pm 30 \times 10^{-6}$  / -20 to +70 °C
- Features : With HFF-XTAL technology  
Fundamental oscillation (100MHz to 230MHz)  
Multiplier oscillation (230MHz to 500MHz)
- Output waveform : Sine wave
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



Actual size

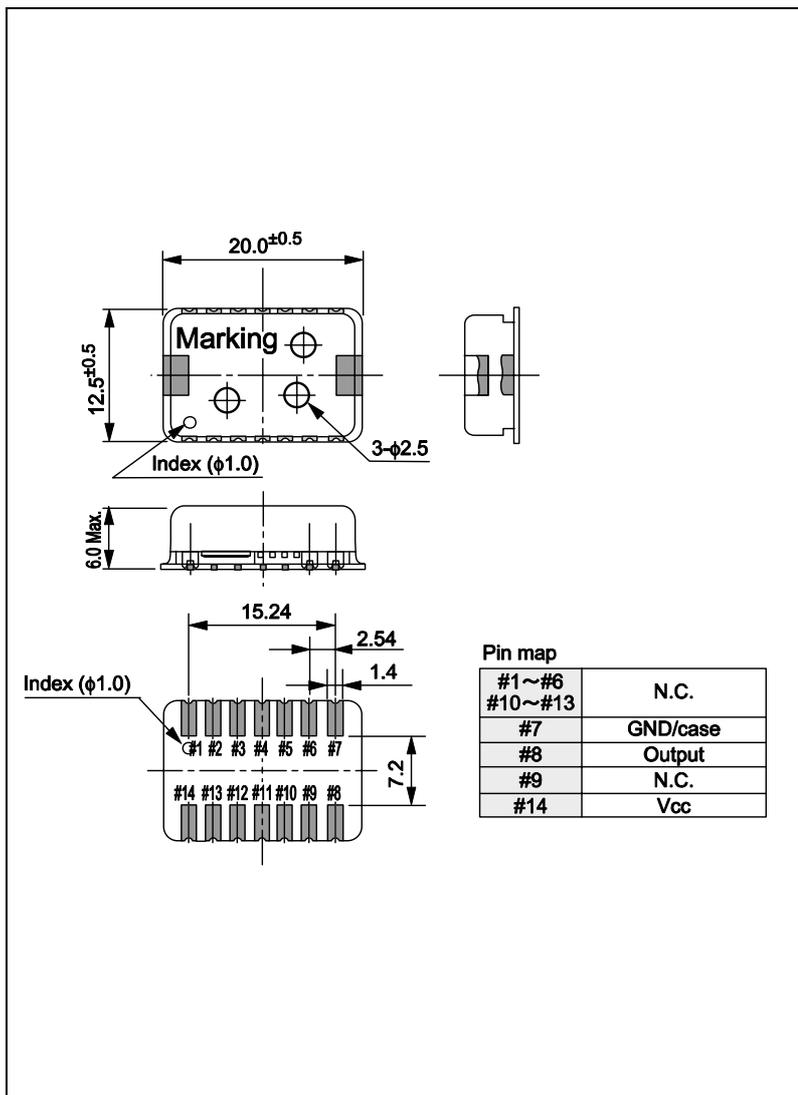


**Specifications (characteristics)**

Item	Symbol	TCO-393F	Remarks
Output frequency range	fo	100.000 MHz to 500.000 MHz	
		155.520 MHz	Standard frequency
Supply voltage	Vcc	3.3 V $\pm$ 0.165 V	
Storage temperature range	T_stg	-40 °C to +85 °C	
Operating temperature range	T_use	-20 °C to +70 °C	
Frequency tolerance	F_tol(osc)	$\pm 35 \times 10^{-6}$ Max.	-20 °C to +70 °C
Current consumption	Icc	40 mA Max.	
Output load condition	RL	50 $\Omega$ (0 dBm Min.)	
Oscillation start up time	tosc	10 ms Max.	Time at minimum supply voltage to be 0 s.
Frequency aging	F_aging	$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, First year

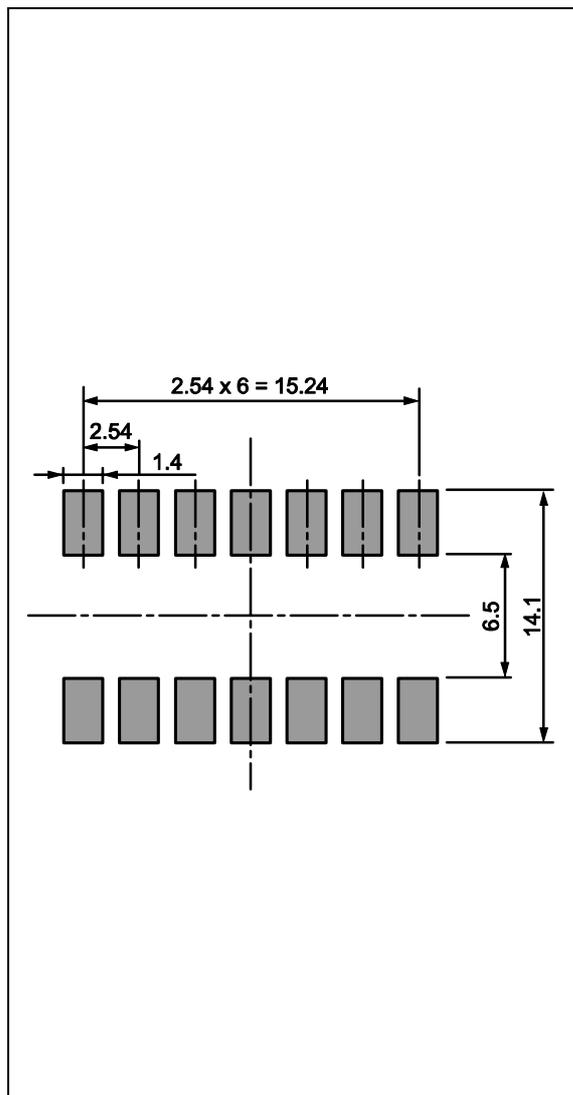
**External dimensions**

(Unit:mm)



**Footprint (Recommended)**

(Unit:mm)



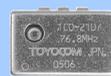
## CRYSTAL OSCILLATOR HIGH-STABILITY

### TCO-3110 Series

- Frequency range : 60 MHz to 800 MHz
- Supply voltage : 3.3 V, 5.0 V
- Frequency stability :  $\pm 30 \times 10^{-6}$  / -40 to +85 °C
- Features : With HFF-XTAL technology  
Fundamental oscillation (60MHz to 230MHz)  
Multiplier oscillation (230MHz to 800MHz)
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



Actual size

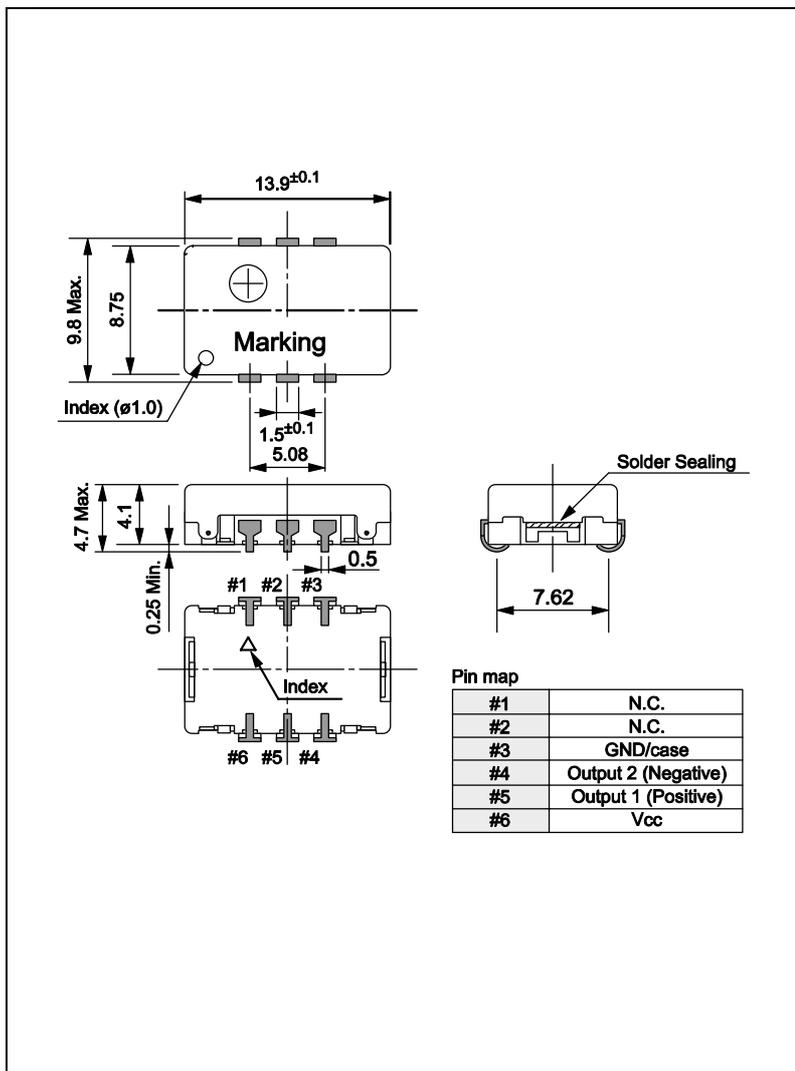


### Specifications (characteristics)

Item	Symbol	TCO-3111	TCO-3112	TCO-3114	Remarks
Output frequency range	fo	60.000 MHz to 800.000 MHz			Standard frequency
		77.760 MHz, 155.520 MHz, 156.250 MHz, 166.6286 MHz, 622.080 MHz, 666.5143 MHz		155.520 MHz	
Supply voltage	Vcc	3.3 V $\pm 0.165$ V	5.0 V $\pm 0.25$ V	3.3 V $\pm 0.165$ V	
Storage temperature range	T_stg	-40 °C to +85 °C			
Operating temperature range	T_use	-40 °C to +85 °C			
Frequency tolerance	F_tol(osc)	$\pm 35 \times 10^{-6}$ Max.			-40 °C to +85 °C
Current consumption	Icc	65 mA Max.		40 mA Max.	
Output load condition	—	LV-PECL	PECL	LV-DS	
Oscillation start up time	t_osc	10 ms Max.			Time at minimum supply voltage to be 0 s.
Frequency aging	F_aging	$\pm 5 \times 10^{-6}$ / year Max.			+25 °C, First year

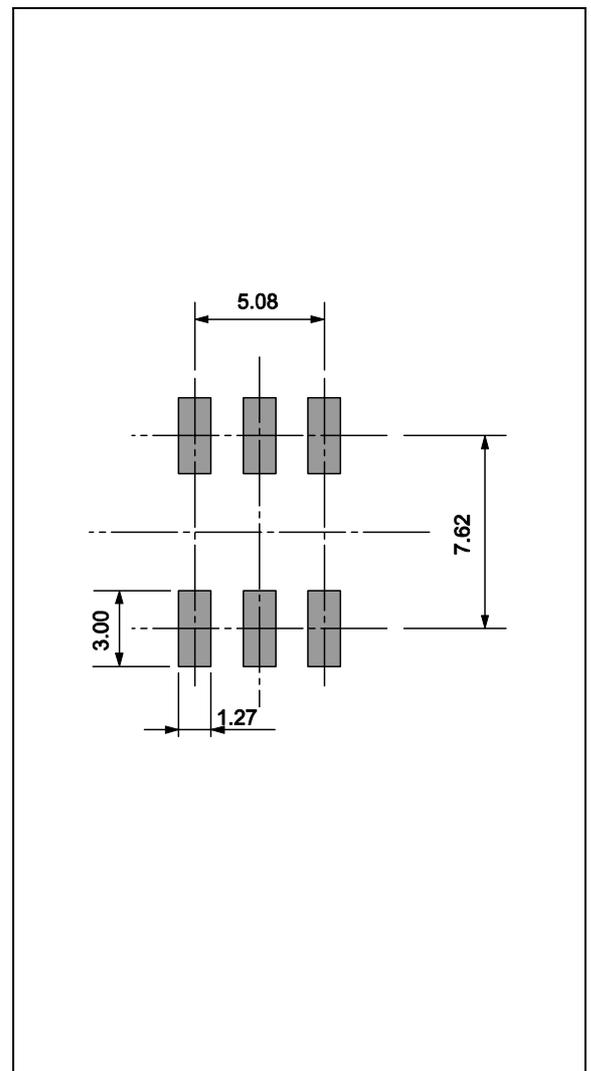
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



**CRYSTAL OSCILLATOR  
HIGH-STABILITY**

**TCO-3131**

- Frequency range : 60 MHz to 700 MHz
- Supply voltage : 3.3 V
- Frequency stability :  $\pm 30 \times 10^{-6}$  / -40 to +85 °C
- Features : With HFF-XTAL technology  
Fundamental oscillation (60MHz to 230MHz)  
Multiplier oscillation (230MHz to 700MHz)
- Function : Output enable(OE)
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



Actual size

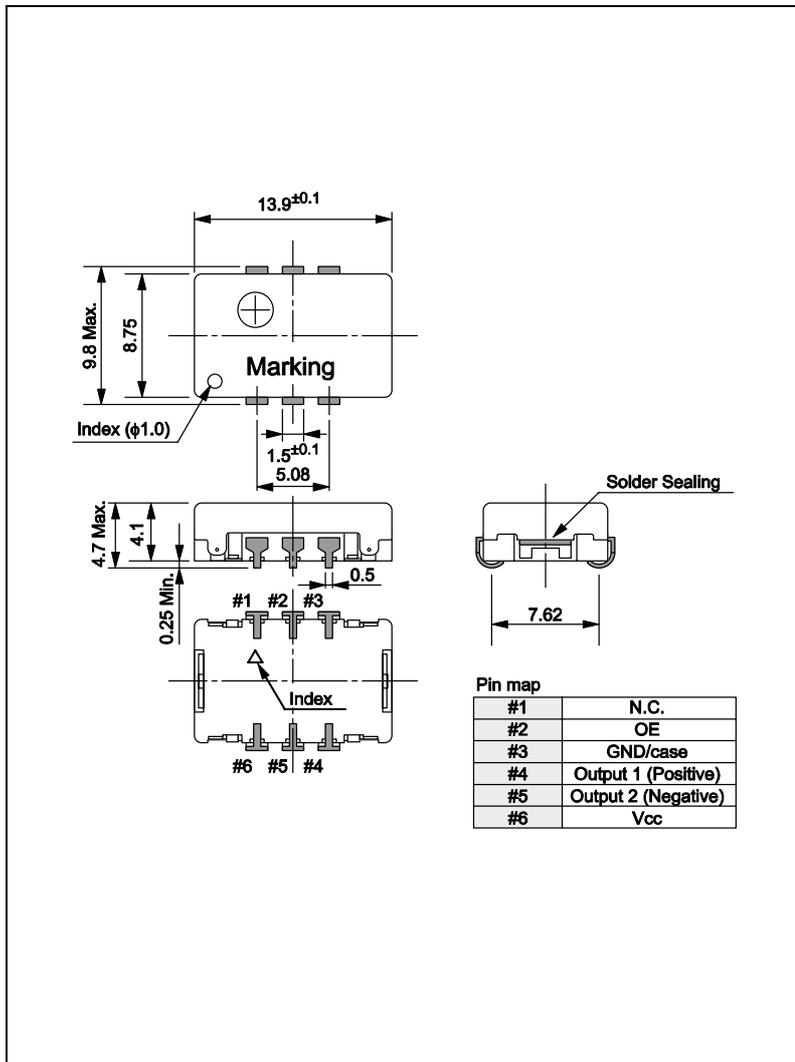


**Specifications (characteristics)**

Item	Symbol	Specifications	Remarks
Output frequency range	fo	60.000 MHz to 700.000 MHz	
		77.760 MHz, 155.520 MHz, 156.250 MHz, 166.6286 MHz, 622.080 MHz, 666.5143 MHz	Standard frequency
Supply voltage	Vcc	3.3 V $\pm 0.165$ V	
Storage temperature range	T_stg	-40 °C to +85 °C	
Operating temperature range	T_use	-40 °C to +85 °C	
Frequency tolerance	F_tol(osc)	$\pm 35 \times 10^{-6}$ Max.	-40 °C to +85 °C
Current consumption	Icc	75 mA Max.	
Output load condition	—	LV-PECL	
Oscillation start up time	tosc	10 ms Max.	Time at minimum supply voltage to be 0 s.
Frequency aging	F_aging	$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, First year

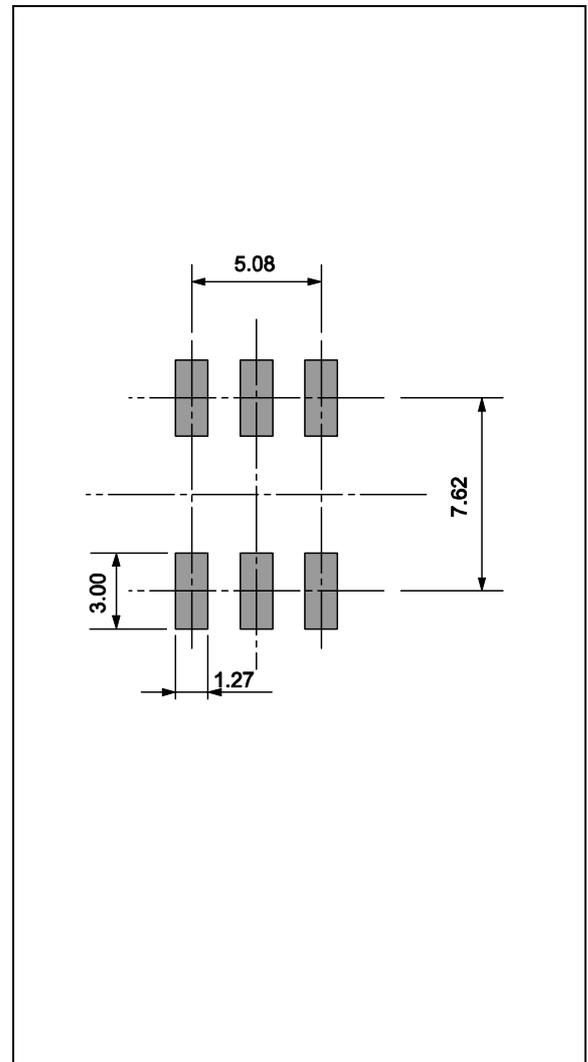
**External dimensions**

(Unit:mm)



**Footprint (Recommended)**

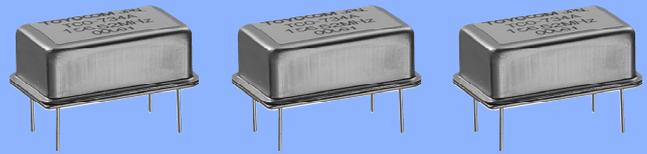
(Unit:mm)



## CRYSTAL OSCILLATOR HIGH-STABILITY

# TCO-743A7, HC7

- Frequency range : 1.5 MHz to 60 MHz
- Supply voltage : 5.0 V
- Features : Hermetic double-sealed metal package
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



Actual size



### Specifications (characteristics)

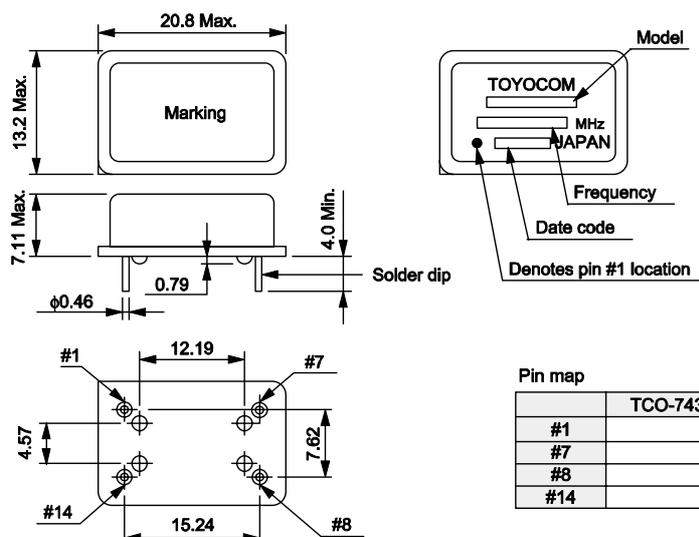
Item	Symbol	TCO-743A7	TCO-743HC7	Remarks
Output frequency range	f <sub>o</sub>	1.500 MHz to 60.000 MHz		Please contact us for inquiries regarding available frequencies.
Supply voltage	V <sub>cc</sub>	5.0 V ±0.25 V		
Storage temperature range	T <sub>stg</sub>	-40 °C to +85 °C		
Operating temperature range	T <sub>use</sub>	0 °C to +70 °C		
Frequency tolerance *1	F <sub>tol(osc)</sub>	±10 × 10 <sup>-6</sup> Max.		0 °C to +70 °C
Current consumption	I <sub>cc</sub>	40 mA Max.	50 mA Max.	No load condition.
Symmetry	SYM	45 % to 55 %		1.4 V level (TCO-743A7) 50 % V <sub>cc</sub> level (TCO-743HC7)
High output voltage	V <sub>OH</sub>	4.0 V Min.	V <sub>cc</sub> -0.4 V Min.	
Low output voltage	V <sub>OL</sub>	0.4 V Max.	0.4 V Max.	
Output load condition (TTL)	L <sub>TTL</sub>	10 TTL Max.	—	
Output load condition (CMOS)	L <sub>CMOS</sub>	—	15 pF Max.	
Rise time / Fall time	t <sub>r</sub> / t <sub>f</sub>	5 ns Max.	12 ns Max.	0.4V to 2.4V level (TCO-743A7) 10 % V <sub>cc</sub> to 90 % V <sub>cc</sub> level (TCO-743HC7)
Oscillation start up time	t <sub>osc</sub>	10 ms Max. *2		Time at minimum supply voltage to be 0 s
Frequency aging	F <sub>aging</sub>	±5 × 10 <sup>-6</sup> /year Max.		+25 °C, V <sub>cc</sub> =5 V, First year

\*1 Inclusive of initial frequency tolerance, temperature variation (except supply voltage variation).

\*2 Rise time ( or to 4.75V) of V<sub>cc</sub> > 150 μs

### External dimensions

(Unit:mm)



**CRYSTAL OSCILLATOR**  
**MULTI-OUTPUT 32.768 kHz and 48 MHz**

**MG - 5020JE**

- Frequency range : 32.768 kHz and 48.00512 MHz
- Supply voltage : 32.768 kHz oscillation circuit 1.8 V to 3.6 V  
 48 MHz oscillation circuit 2.7 V to 3.6 V.
- Built-in crystal : 32.768 kHz crystal unit
- Thickness : 1.5 mm Max.
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.



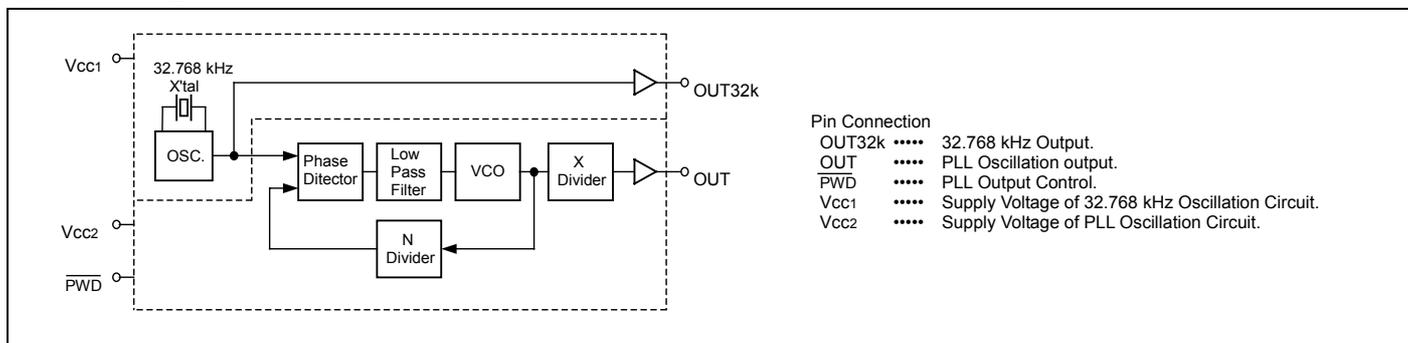
Actual size



**Specifications (characteristics)**

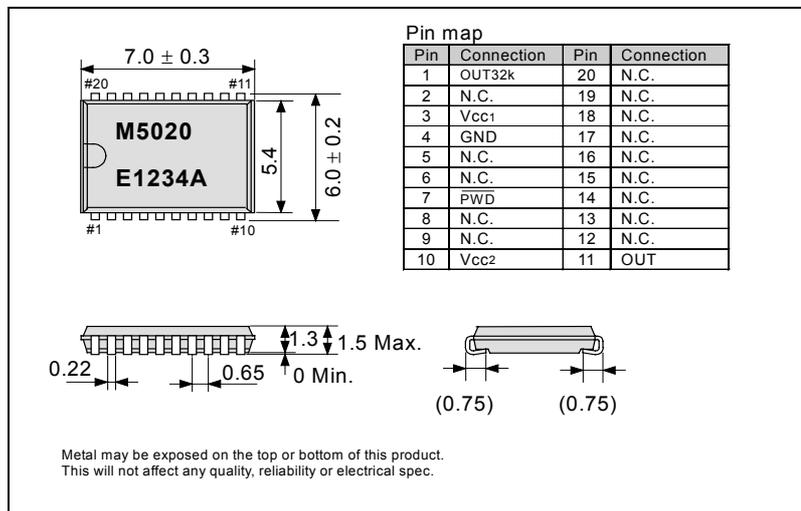
Item	Symbol	Specifications	Remarks
Output frequency range	f <sub>0</sub>	32.768 kHz	OUT32k - pin
		48.005120 MHz	OUT - pin
Supply voltage	V <sub>CC</sub>	2.7 V to 3.6 V	PLL Output
	V <sub>BK</sub>	1.8 V to 3.6 V	32.768 kHz Output
Storage temperature	T <sub>stg</sub>	-55 °C to +125 °C	Stored as bare product after unpacking
Operating temperature	T <sub>use</sub>	-40 °C to +85 °C	
Frequency tolerance	F <sub>tol(osc)</sub>	5 ±23 × 10 <sup>-6</sup>	+25 °C, V <sub>CC</sub> =3.0 V
Current consumption 1 (PLL Stopping)	I <sub>cc1</sub>	3 µA Max.	V <sub>CC</sub> =1.8 V to 3.6 V PWD =GND OUT32 k=No load condition
Current consumption 2 (PLL Working)	I <sub>cc2</sub>	15 mA Max.	V <sub>CC</sub> =2.7 V to 3.6 V PWD =HIGH OUT= No load condition
Symmetry	SYM	40 % to 60 %	50 % V <sub>CC</sub> level
High output voltage	V <sub>OH</sub>	V <sub>CC</sub> -0.4 V Min.	I <sub>OH</sub> =100 µA(OUT32k), 4.0 mA(OUT)
Low output voltage	V <sub>OL</sub>	0.4 V Max.	I <sub>OL</sub> =-100 µA(OUT32k), -4.0 mA(OUT)
Output load condition (CMOS)	L <sub>CMOS</sub>	15 pF Max.	OUT32k pin, OUT pin
Output enable input voltage	V <sub>IH</sub>	80 % V <sub>CC</sub> to V <sub>CC</sub> +0.2 V	PWD pin
Output disenable input voltage	V <sub>IL</sub>	GND-0.2 V to 0.2 V <sub>CC</sub>	PWD pin
Output rise time	t <sub>r</sub>	5 ns Max.	20 % V <sub>CC</sub> →80 % V <sub>CC</sub> level, OUT pin
Output fall time	t <sub>f</sub>	5 ns Max.	80 % V <sub>CC</sub> →20 % V <sub>CC</sub> level, OUT pin
Jitter	P <sub>j</sub>	150 ps Max.	V <sub>CC</sub> =2.7 V to 3.6 V Period jitter
Oscillation start up time	t <sub>STAI</sub>	3 s Max.	+25 °C, V <sub>CC</sub> =0 V→1.8 V to 3.6 V
	t <sub>STAP</sub>	0.1 s	V <sub>CC</sub> =0 V → 2.7 V to 3.6 V, PWD=LOW→High
Frequency aging	F <sub>aging</sub>	±5 × 10 <sup>-6</sup> / year Max.	+25 °C, V <sub>CC</sub> = 3.0 V, First year

**Block diagram**



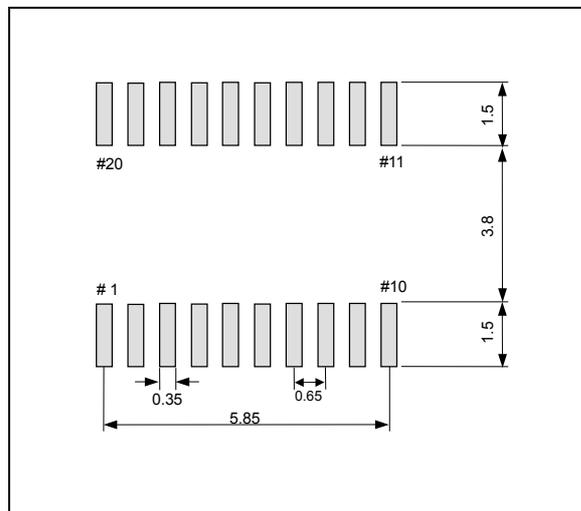
**External dimensions**

(Unit:mm)



**Footprint (Recommended)**

(Unit:mm)



## CRYSTAL OSCILLATOR MULTI-OUTPUT

# MG - 5100SA series

- Frequency range : 76.9 kHz to 100 MHz
- Supply voltage : 3.3 V or 5.0 V
- Built-in crystal : AT crystal unit
- Thickness : 3.2 mm Typ.
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.
- Available output in 6 frequencies.



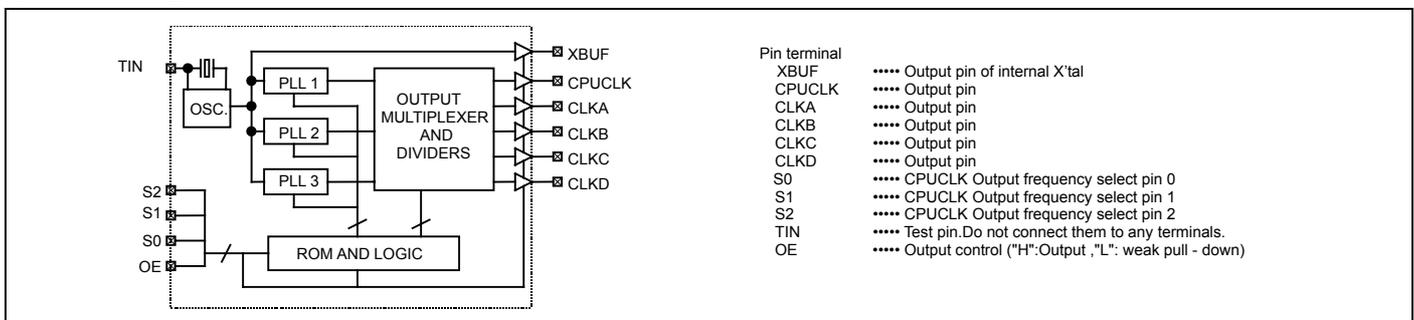
Actual size



### Specifications (characteristics)

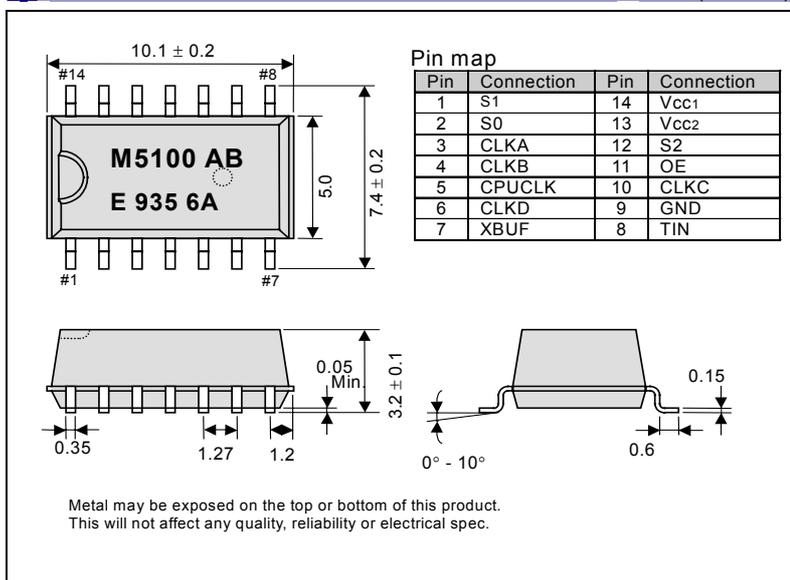
Item	Symbol	Specifications		Remarks
		V <sub>CC</sub> =5.0V	V <sub>CC</sub> =3.3V	
Output frequency range	f <sub>0</sub>	76.9 kHz to 100 MHz	76.9 kHz to 80 MHz	Please contact us for inquiries regarding available frequencies.
Supply voltage	V <sub>CC</sub>	5.0 V ±0.5 V	3.3 V ±0.3 V	
Temperature range	Storage temperature	T <sub>stg</sub> -55 °C to +100 °C		Stored as bare product after unpacking
	Operating temperature	T <sub>use</sub> -20 °C to +70 °C		
Frequency tolerance	F <sub>tol(osc)</sub>	±100 × 10 <sup>-6</sup>		
Current consumption	I <sub>CC</sub>	100 mA Max.	65 mA Max.	No load, Max. frequency
Symmetry	SYM	40 % to 60 %		CMOS load: 50 % V <sub>CC</sub> level, L <sub>CMOS</sub> =15 pF
High output voltage	V <sub>OH</sub>	V <sub>CC</sub> -0.4 V Min.		I <sub>OH</sub> =4 mA
Low output voltage	V <sub>OL</sub>	0.4 V Max.		I <sub>OL</sub> =4 mA
Output load condition (CMOS)	L <sub>CMOS</sub>	25 pF Max.	15 pF Max.	Max. frequency and Max. supply voltage
Output enable / disable input voltage	V <sub>IH</sub>	80 % V <sub>CC</sub> Min.		
	V <sub>IL</sub>	20 % V <sub>CC</sub> Max.		
Output rise time	t <sub>r</sub>	5 ns Max.		20 % V <sub>CC</sub> →80 % V <sub>CC</sub> level
Output fall time	t <sub>f</sub>	4 ns Max.		80 % V <sub>CC</sub> →20 % V <sub>CC</sub> level
Jitter	t <sub>j</sub>	450 ps Max.		Cycle to Cycle jitter
		500 ps Max.		Peak to Peak jitter
		500 ps Max.		Please contact us for inquiries about details.
Skew	t <sub>skw</sub>	70 ms Max.		Time at minimum supply voltage to be 0 s.
Oscillation start up time	t <sub>osc</sub>	70 ms Max.		Time at minimum supply voltage to be 0 s.
Frequency aging	F <sub>aging</sub>	±5 × 10 <sup>-6</sup> / year Max.		+25 °C, V <sub>CC</sub> =5.0 V/ 3.3 V, First year

### Block diagram



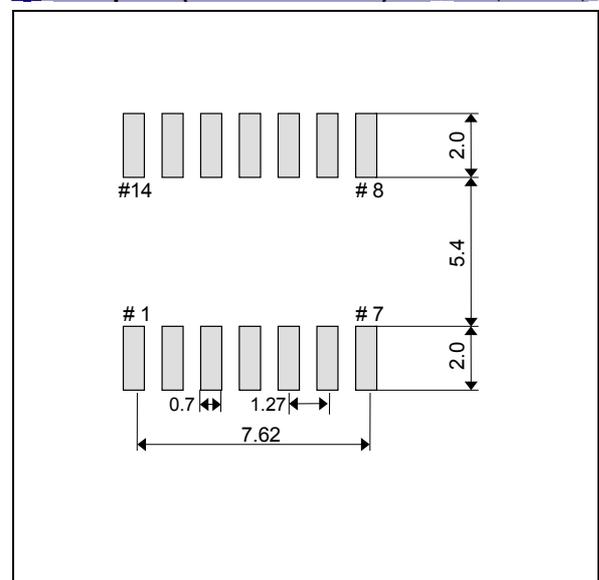
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)







# Voltage Controlled Crystal Oscillator (VCXO)

Category	Model	Actual size (mm) Typ.	Frequency range	Page.
VCXO	TCO-7106Z1Z	 5.0×3.2×1.2 t	1.5 MHz ~ 52 MHz	68
	TCO-7116Z1Z4	 7.0×5.0×1.6 t	60 MHz ~ 80 MHz	69
	TCO-7116X1V		1.5 MHz ~ 55 MHz	70
	VG-4231CE	 3.2×2.5×1.05 t	12 MHz ~ 48 MHz	71
	VG-4231CA (Wide pull range)	 7.0×5.0×1.4 t	1 MHz ~ 75 MHz	72
	VG-1201CA		1 MHz ~ 80 MHz	73
	TCO-291B/C Series	 9.6×11.4×5.0 t (Max.)	8 MHz ~ 125 MHz	74
	TCO-291J/X	 11.4×9.6×4.0 t (Max.)	60 MHz ~ 230 MHz	75
	TCO-293 Series	 20×12.5×6.0 t (Max.)	60 MHz ~ 800 MHz	76
	TCO-294J (PIN 3:3)	 11.4×9.6×2.0 t (Max.)	100 MHz ~ 690 MHz	77
	TCO-296 Series (PIN 4:2)		100 MHz ~ 690 MHz	78
	TCO-2000/2100 Series	 8 MHz ~ 125 MHz	79	
	TCO-2106/2107	 13.9×9.8×4.7 t (Max.)	1 MHz ~ 80 MHz	80
	TCO-2110 Series		60 MHz ~ 800 MHz	81
	TCO-2131 (OE)		60 MHz ~ 700 MHz	82
	TCO-2152	 7.0×5.2×2.0 t (Max.)	77 MHz ~ 230 MHz	83
	TCO-726BVX/DVX	 14.22×9.14×5.0 t (Max.)	1.5 MHz ~ 34 MHz	84
	TCO-7026X1V2		34 MHz ~ 67 MHz	85
	VG-4030JA	 14.0×9.8×4.7 t (Max.)	2 MHz ~ 28.63636 MHz	86
	TCO-756BVX7/DVX7	 DIP full size	1.5 MHz ~ 40 MHz	87
	TCO-734A TCO-735 Series		60 MHz ~ 230 MHz	88
	TCO-7302 Series		8 MHz ~ 52 MHz	89

VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

TCO-7106Z1Z

- Frequency range : 1.5 MHz to 52 MHz
- Supply voltage : 3.3 V
- Frequency control range :  $\pm 75 \times 10^{-6}$
- Thickness : 1.4mm Max.
- Function : Output enable(OE)
- Lead(Pb)-free : Lead free completely



Actual size



Specifications (characteristics)

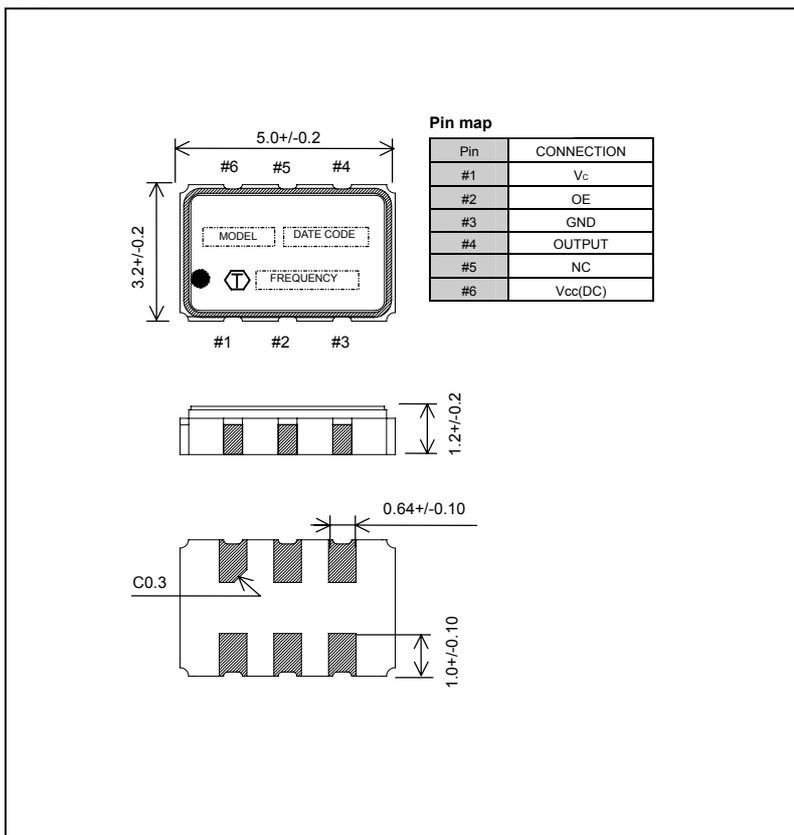
Item	Symbol	TCO-7106Z1Z	Remarks
Output frequency range	$f_o$	1.500 MHz to 52.000 MHz	Please contact us for inquiries regarding available frequencies.
Supply voltage	V <sub>cc</sub>	3.3 V $\pm$ 0.15 V	
Storage temperature range	T <sub>stg</sub>	-40 °C to +85 °C	
Operating temperature range	T <sub>use</sub>	0 °C to +70 °C	
Frequency tolerance	F <sub>tol(osc)</sub>	$\pm 50 \times 10^{-6}$ Max.	0 °C to +70 °C
Current consumption	I <sub>cc</sub>	35 mA Max.	No load condition.
Frequency control range	F <sub>cont</sub>	$\pm 75 \times 10^{-6}$ Min.	V <sub>c</sub> = 1.65 V $\pm$ 1.65 V
Input resistance	R <sub>in</sub>	80 k $\Omega$ Min.	DC level
Frequency change polarity	—	Positive slope	V <sub>c</sub> = 0 to 3.3 V
Symmetry	SYM	40 % to 60 %	50 % V <sub>cc</sub> level
High output voltage	V <sub>OH</sub>	90 % V <sub>cc</sub> Min.	I <sub>OH</sub> = -0.8mA
Low output voltage	V <sub>OL</sub>	10 % V <sub>cc</sub> Max.	I <sub>OL</sub> = 3.2mA
Output load condition (CMOS)	L <sub>CMOS</sub>	15 pF Max.	
Output enable / disable input voltage	V <sub>IH</sub> V <sub>IL</sub>	70 % V <sub>cc</sub> Min. 30 % V <sub>cc</sub> Max.	V <sub>IH</sub> or OPEN : Enable V <sub>IL</sub> or GND : Disable
Rise time / Fall time	t <sub>r</sub> / t <sub>f</sub>	5 ns Max.	20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level
Oscillation start up time	t <sub>osc</sub>	10 ms Max.*1	Time at minimum supply voltage to be 0 s
Frequency aging	F <sub>aging</sub>	$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, V <sub>cc</sub> =3.3 V, First year

\*1 Rise time (or to 3.15 V) of V<sub>cc</sub> > 150  $\mu$ s.

\* Give the V<sub>c</sub> voltage at the time of the power supply input as GND or open without fail.

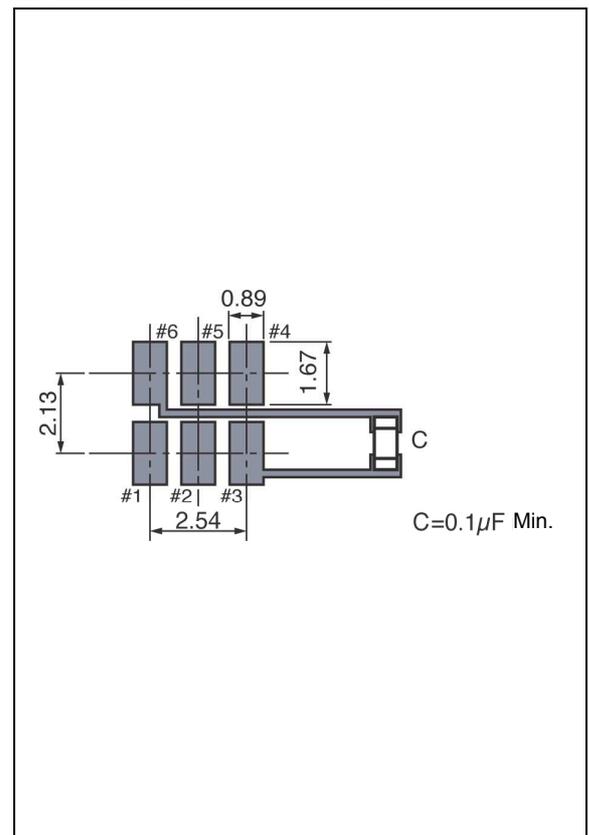
External dimensions

(Unit :mm)



Footprint (Recommended)

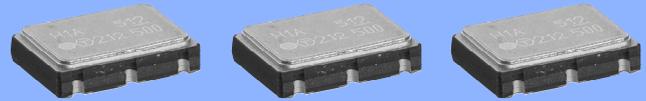
(Unit :mm)



## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## TCO-7116Z1Z4

- Frequency range : 60 MHz to 80 MHz
- Supply voltage : 3.3 V
- Absolute pull range :  $\pm 50 \times 10^{-6}$
- Thickness : 1.6 mm Max.
- Function : Output enable(OE)
- Lead(Pb)-free : Lead free completely



Actual size



## Specifications (characteristics)

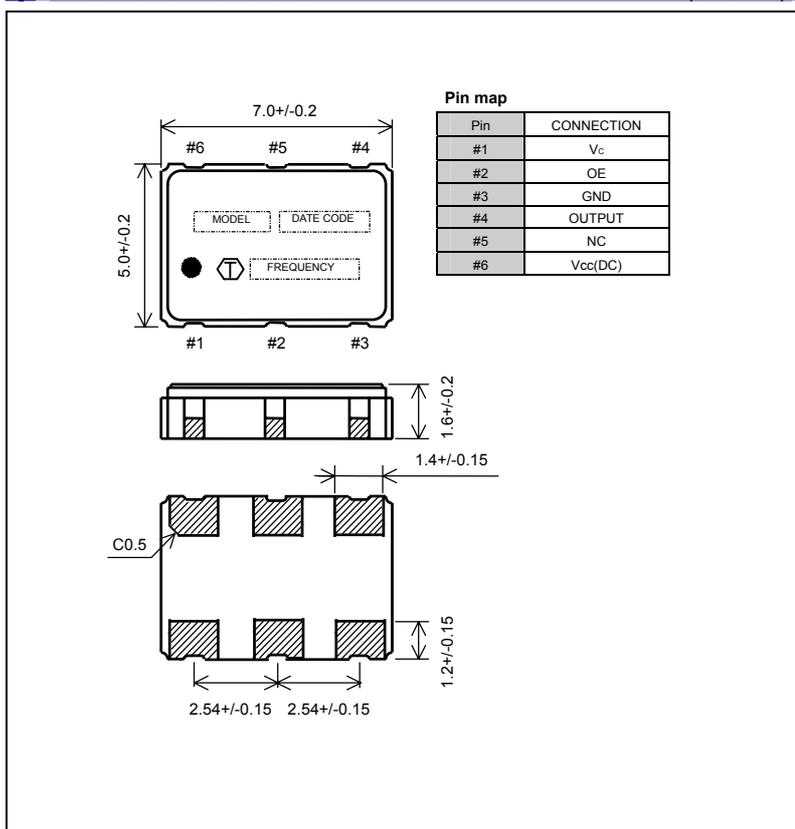
Item	Symbol	TCO-7116Z1Z4	Remarks
Output frequency range	$f_o$	60.000 MHz to 80.000 MHz	Please contact us for inquiries regarding available frequencies.
Supply voltage	V <sub>CC</sub>	3.3 V $\pm 0.165$ V	
Storage temperature range	T <sub>stg</sub>	-40 °C to +85 °C	
Operating temperature range	T <sub>use</sub>	-40 °C to +85 °C	
Frequency tolerance	F <sub>tol(osc)</sub>	$\pm 50 \times 10^{-6}$ Max.	-40 °C to +85 °C
Current consumption	I <sub>cc</sub>	35 mA Max.	No load condition.
Absolute pull range	APR	$\pm 50 \times 10^{-6}$ Min.	V <sub>C</sub> = 1.65 V $\pm 1.65$ V
Input resistance	R <sub>in</sub>	80 k $\Omega$ Min.	DC level
Frequency change polarity	—	Positive slope	V <sub>C</sub> = 0 to 3.3 V
Symmetry	SYM	45 % to 55 %	50 % V <sub>CC</sub> level
High output voltage	V <sub>OH</sub>	90 % V <sub>CC</sub> Min.	I <sub>OH</sub> = -0.8mA
Low output voltage	V <sub>OL</sub>	10 % V <sub>CC</sub> Max.	I <sub>OL</sub> = 3.2mA
Output load condition (CMOS)	L <sub>CMOS</sub>	15 pF Max.	
Output enable / disable input voltage	V <sub>IH</sub>	70 % V <sub>CC</sub> Min.	V <sub>IH</sub> or OPEN : Enable
	V <sub>IL</sub>	30 % V <sub>CC</sub> Max.	V <sub>IL</sub> or GND : Disable
Rise time / Fall time	t <sub>r</sub> / t <sub>f</sub>	5 ns Max.	20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> level
Oscillation start up time	t <sub>osc</sub>	10 ms Max.	Time at minimum supply voltage to be 0 s
Frequency aging	F <sub>aging</sub>	$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, V <sub>CC</sub> = 3.3 V, First year

\*1 Rise time (or 3.15 V) of V<sub>CC</sub> > 150  $\mu$ s.

\* Give the V<sub>C</sub> voltage at the time of the power supply input as GND or open without fail.

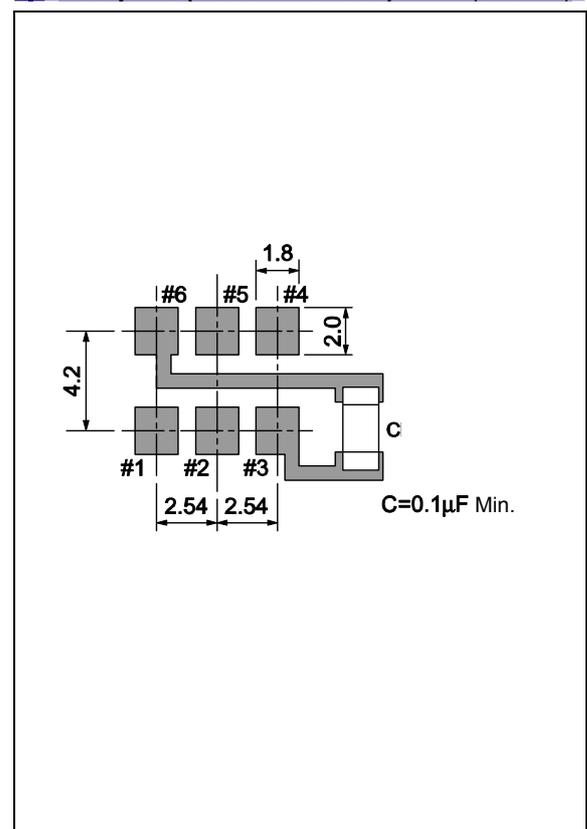
## External dimensions

(Unit :mm)



## Footprint (Recommended)

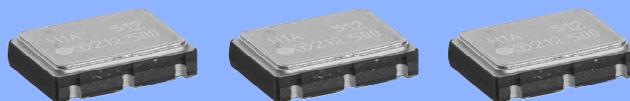
(Unit :mm)



VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

TCO-7116X1V

- Frequency range : 1.5 MHz to 55 MHz
- Supply voltage : 3.3 V
- Frequency control range :  $\pm 100 \times 10^{-6}$
- Thickness : 1.8 mm Max.
- Function : Output enable(OE)
- Lead(Pb)-free : Lead free completely



Actual size



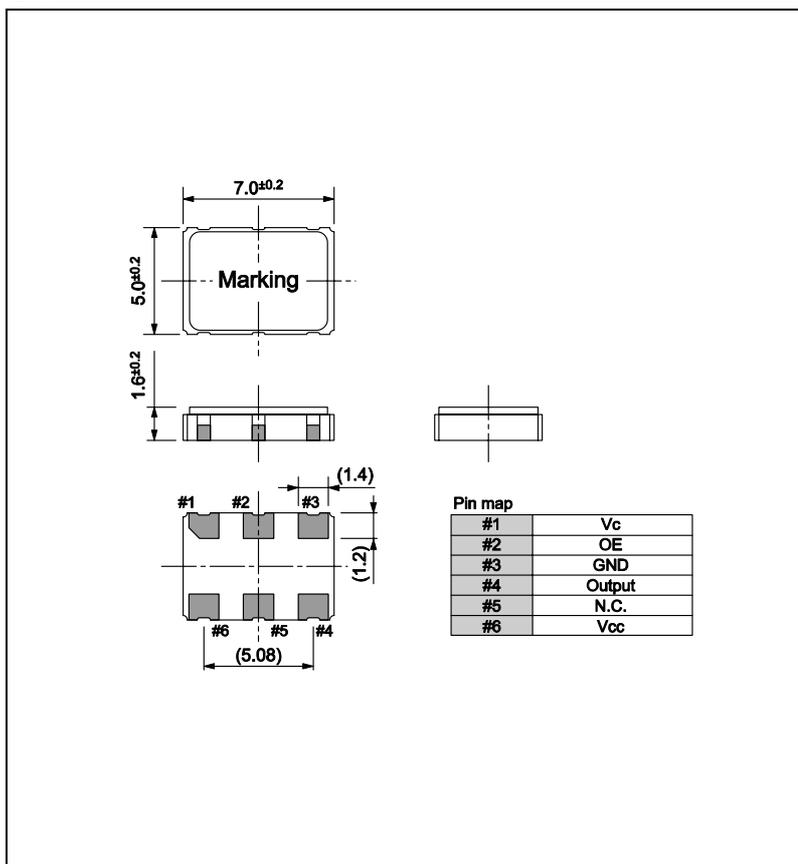
Specifications (characteristics)

Item	Symbol	TCO-7116X1V	Remarks
Output frequency range	$f_o$	1.500 MHz to 55.000 MHz	Please contact us for inquiries regarding available frequencies.
Supply voltage	Vcc	3.3 V $\pm 0.165$ V	
Storage temperature range	T_stg	-40 °C to +85 °C	
Operating temperature range	T_use	0 °C to +70 °C	
Frequency tolerance	F_tol(osc)	$\pm 50 \times 10^{-6}$ Max.	0 °C to +70 °C
Current consumption	Icc	40 mA Max.	No load condition.
Frequency control range	Fcont	$\pm 100 \times 10^{-6}$ Min.	Vc= 1.65 V $\pm 1.65$ V
Input resistance	Rin	80 k $\Omega$ Min.	DC level
Frequency change polarity	—	Positive slope	Vc= 0 to 3.3 V
Symmetry	SYM	40 % to 60 %	50 % Vcc level
High output voltage	VOH	Vcc-0.4 V Min.	
Low output voltage	VOL	0.4 V Max.	
Output load condition (CMOS)	L_CMOS	15 pF Max.	
Output enable / disable input voltage	V <sub>IH</sub>	70 % Vcc Min.	V <sub>IH</sub> or OPEN : Enable
	V <sub>IL</sub>	30 % Vcc Max.	V <sub>IL</sub> or GND : Disable
Rise time / Fall time	t <sub>r</sub> / t <sub>f</sub>	10 ns Max.	20 % Vcc to 80 % Vcc level
Oscillation start up time	t <sub>osc</sub>	5 ms Max.	Time at minimum supply voltage to be 0 s
Frequency aging	F_aging	$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, Vcc=3.3 V, First year

\*1 Give the Vc voltage at the time of the power supply input as GND or open without fail.

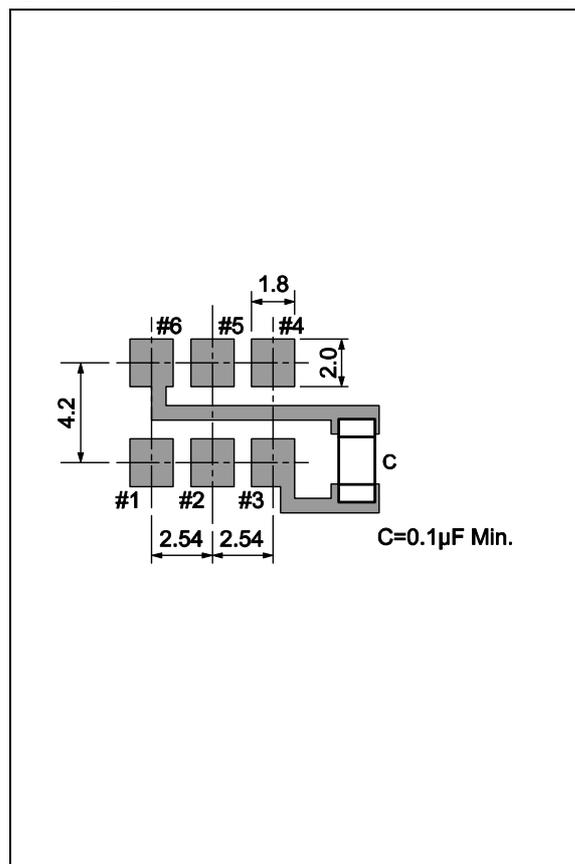
External dimensions

(Unit :mm)



Footprint (Recommended)

(Unit :mm)



## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO) MINIATURE SIZE LOW PROFILE, WIDE PULL RANGE

### VG - 4231CE

- Frequency range : 12 MHz to 48 MHz
- Supply voltage : 3.3 V (DJK,GJK)  
2.8 V (DNM,GNM)
- Frequency control range :  $\pm 100 \times 10^{-6}$  (DNM,GNM)
- Low current consumption : 1.3 mA Typ. (27MHz)
- Thickness : 1.05 mm Typ.
- Lead(Pb)-free : Lead free completely



Actual size



### Specifications (characteristics)

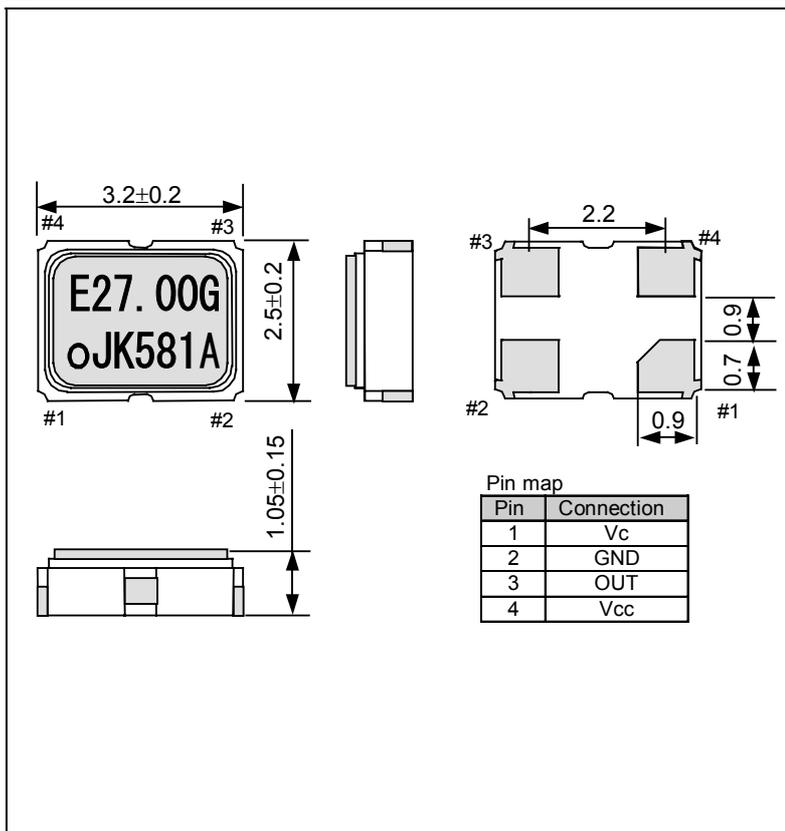
Item	Symbol	Specifications		Remarks
		DJK / GJK	DNM / GNM	
Output frequency range	$f_o$	12.000 MHz to 48.000 MHz	27.000 MHz to 32.000 MHz	Please contact us for inquiries regarding other frequencies.
Supply voltage	$V_{cc}$	3.3 V $\pm 0.3$ V	2.8 V $\pm 0.2$ V	
Temperature range	Storage temperature	-40 °C to +125 °C		Stored as bare product after unpacking
	Operating temperature	As per below table		
Frequency tolerance	$F_{tol(osc)}$	As per below table		$V_c=1.65$ V (DJK,GJK) / $V_c=1.40$ V (DNM,GNM)
Current consumption	$I_{cc}$	3.5 mA Max.		No load condition
Frequency control range	$F_{cont}$	J: $\pm 70 \times 10^{-6}$	—	$V_c=1.65$ V $\pm 1.50$ V (DJK,GJK)
		—	N: $\pm 100 \times 10^{-6}$	$V_c=1.40$ V $\pm 1.40$ V (DNM,GNM)
Modulation characteristics	BW	15 kHz Min.		$\pm 3$ dB (at 1kHz)
Input resistance	$R_{in}$	K : 100 k $\Omega$ Min.	M : 1 M $\Omega$ Min.	DC level
Frequency change polarity	—	Positive polarity		$V_c=0.15$ V to 3.15 V (**K) , 0 V to 2.8 V (**M)
Symmetry	SYM	40 % to 60 %		CMOS load: 50 % $V_{cc}$ level
High output voltage	$V_{OH}$	$V_{cc}-0.4$ V Min.		$I_{OH}=-0.8$ mA
Low output voltage	$V_{OL}$	0.4 V Max.		$I_{OL}=3.2$ mA
Output load condition (CMOS)	L_CMOS	15 pF Max.		CMOS load
Output rise and fall time	$t_r / t_f$	4 ns Max.		CMOS load: 20 % $V_{cc}$ to 80 % $V_{cc}$ level
Oscillation start up time	$t_{osc}$	5 ms Max.		Time at 90 % $V_{cc}$ to be 0 s
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max.		+25 °C, First year

### Frequency tolerance / Temperature range

	Frequency tolerance	Temperature range
DJK / DNM	$\pm 35 \times 10^{-6}$	-20 °C to +70 °C
GJK / GNM	$\pm 50 \times 10^{-6}$	-40 °C to +85 °C

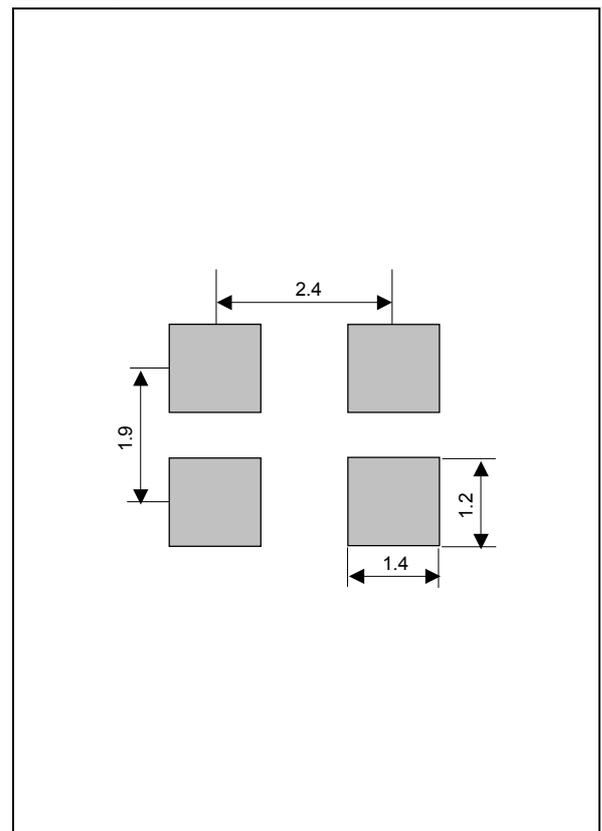
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



**VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)  
WIDE PULL RANGE**

**VG-4231CA**

- Frequency range : 1 MHz to 75 MHz
- Supply voltage : 3.3 V (DRC,GRC)  
5.0 V (DRH,GRH)
- Frequency control range:  $\pm 130 \times 10^{-6}$
- Thickness : 1.4 mm Typ.
- Lead(Pb)-free : Lead free completely



Actual size



**Specifications (characteristics)**

Item	Symbol	Specifications		Remarks
		DRH / GRH	DRC / GRC	
Output frequency range	$f_0$	1.000 MHz to 60.000 MHz	1.000 MHz to 75.000 MHz	Please contact us for inquiries regarding available frequencies.
Supply voltage	$V_{cc}$	H:5.0 V $\pm 0.5$ V	C:3.3 V $\pm 0.3$ V	
Temperature range	$T_{stg}$	-40 °C to +125 °C		Stored as bare product after unpacking
Operating temperature	$T_{use}$	As per below table		
Frequency tolerance	$F_{tol(osc)}$	As per below table		$V_c=2.5$ V(DRH,GRH)/ $V_c=1.65$ V(DRC,GRC)
Current consumption	$I_{cc}$	20 mA Max.	10 mA Max.	No load condition
Output disable current	$I_{dis}$	15 mA Max.	7 mA Max.	OE=GND
Frequency control range	$F_{cont}$	R: $\pm 130 \times 10^{-6}$ (1 MHz< $f_0$ ≤42 MHz) Q: $\pm 120 \times 10^{-6}$ (42 MHz< $f_0$ ≤75 MHz)		$V_c=2.5$ V $\pm 2.0$ V(DRH,GRH) $V_c=1.65$ V $\pm 1.5$ V(DRC,GRC)
Absolute pull range *1	APR	DR: $\pm 80 \times 10^{-6}$ Min., GR: $\pm 65 \times 10^{-6}$ Min.		Frequency control range: $\pm 130 \times 10^{-6}$
Modulation characteristics	BW	15 kHz Min.		$\pm 3$ dB (at 1kHz)
Input resistance	$R_{in}$	50 k $\Omega$ Min.		DC level
Frequency change polarity	—	Positive polarity		$V_c=0.5$ V to 4.5 V(**H) , 0.15 V to 3.15 V(**C)
Symmetry	SYM	40 % to 60 %		CMOS load:50 % $V_{cc}$ level
High output voltage	$V_{OH}$	$V_{cc}-0.4$ V Min.		$I_{OH}=-0.8$ mA(DRC,GRC), $I_{OH}=-4$ mA(DRH,GRH)
Low output voltage	$V_{OL}$	0.4 V Max.		$I_{OL}=3.2$ mA(DRC,GRC), $I_{OL}=4$ mA(DRH,GRH)
Output load condition(CMOS)	$L_{CMOS}$	15 pF Max.		CMOS load
Output enable / disable input voltage	$V_{IH}$ $V_{IL}$	70 % $V_{cc}$ Min. 30 % $V_{cc}$ Max.		OE Terminal
Output rise and fall time	$t_r / t_f$	4 ns Max.		CMOS load: 20 % $V_{cc}$ to 80 % $V_{cc}$ level
Oscillation start up time	$t_{osc}$	10 ms Max.		Time at 90 % $V_{cc}$ to be 0 s
Frequency aging	$F_{aging}$	$\pm 10 \times 10^{-6}$ Max. *2		+25 °C, 10 years

\*1 Absolute pull range = Frequency control range- (Frequency tolerance + 10 years Aging + Free fall + Vibration)

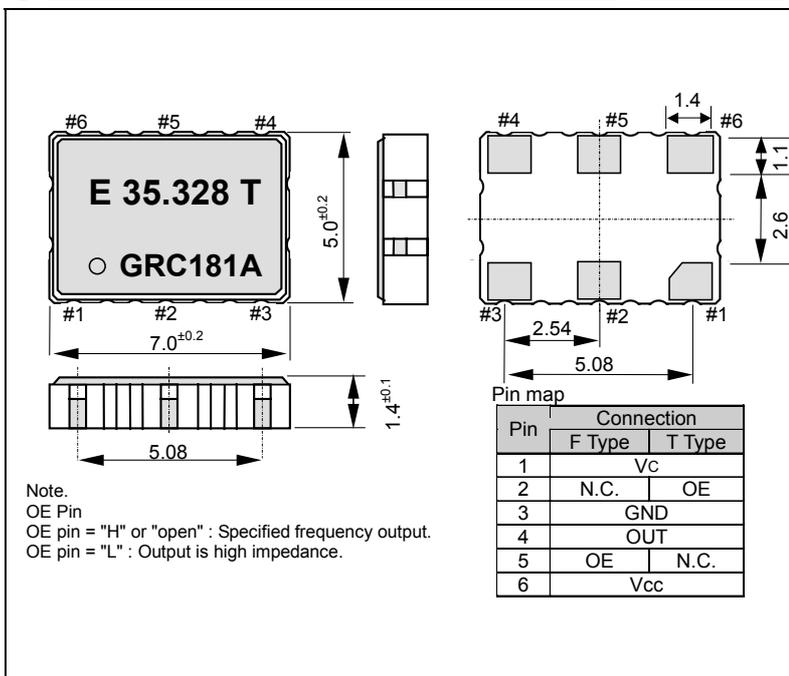
\*2 50 MHz <  $f_0$  ≤ 75 MHz :  $\pm 15 \times 10^{-6}$  Max.

**Frequency tolerance / Temperature range**

	Frequency tolerance	Temperature range
DRC / DRH / DQC	$\pm 35 \times 10^{-6}$	-20 °C to +70 °C
GRC / GRH / GQC	$\pm 50 \times 10^{-6}$	-40 °C to +85 °C

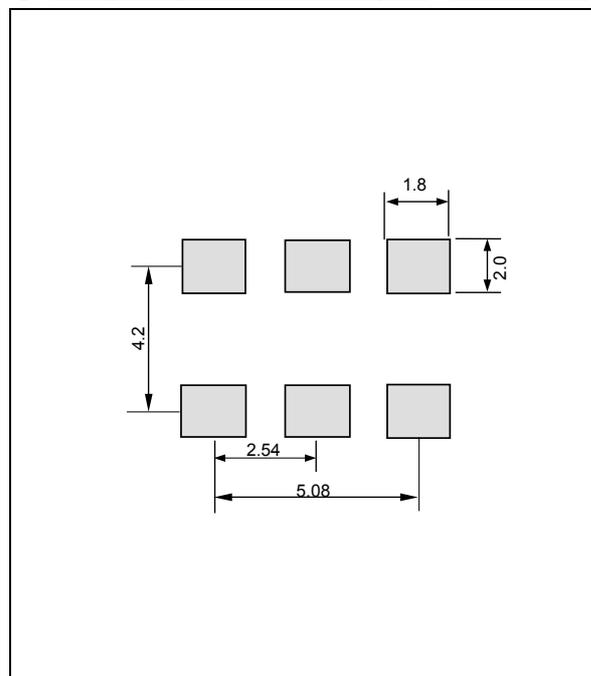
**External dimensions**

(Unit:mm)



**Footprint (Recommended)**

(Unit:mm)



## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## VG-1201CA

- Frequency range : 1 MHz to 80 MHz
- Supply voltage : 3.3 V(\*\*C) or 5.0V(\*\*H)
- Function : Output enable(OE)
- Thickness : 1.4 mm Typ.
- Lead(Pb)-free : Lead free completely



Actual size



## Specifications (characteristics)

Item	Symbol	Specifications		Remarks
		ANH / AKH / BNH / BKH	ANC / AKC / BNC / BKC	
Output frequency range	$f_o$	1.000 MHz to 80.000 MHz		60 MHz < $f_o$ ≤ 80 MHz Please contact us for inquiries *1
Supply voltage	$V_{cc}$	H:5.0 V ±0.5 V	C:3.3 V ±0.3 V	
Temperature range	Storage temperature	-40 °C to +125 °C		Stored as bare product after unpacking
	Operating temperature	As per below table		
Frequency tolerance	$F_{tol(osc)}$	As per below table		
Current consumption	$I_{cc}$	30 mA Max.	25 mA Max.	No load condition
Output disable current	$I_{dis}$	15 mA Max.	12 mA Max.	OE=GND
Frequency control range	$F_{cont}$	As per below table		$V_c=2.5 V \pm 2.0 V(**H)$ , $1.65 V \pm 1.50 V(**C)$
Modulation characteristics	BW	20 kHz Min.		± 3 dB (at 1kHz)
Input resistance	$R_{in}$	5 M $\Omega$ Min.		DC level
Frequency change polarity	—	Positive polarity		$V_c=0.5 V$ to $4.5 V(**H)$ , $0.15 V$ to $3.15 V(**C)$
Symmetry	SYM	40 % to 60 %		CMOS load:50 % $V_{cc}$ level
High output voltage	$V_{OH}$	$V_{cc}-0.4 V$ Min.		$I_{OH}=-4 mA$
Low output voltage	$V_{OL}$	0.4 V Max.		$I_{OL}=4 mA$
Output load condition(CMOS)	$L_{CMOS}$	15 pF Max.		CMOS load
Output enable / disable input voltage	$V_{IH}$	70 % $V_{cc}$ Min.		OE Terminal
	$V_{IL}$	30 % $V_{cc}$ Max.		
Output rise and fall time	$t_r / t_f$	4 ns Max.		CMOS load: 20 % $V_{cc}$ to 80 % $V_{cc}$ level
Oscillation start up time	$t_{osc}$	10 ms Max.		Time at 90 % $V_{cc}$ to be 0 s
Frequency aging	$F_{aging}$	±10 × 10 <sup>-6</sup> Max. *2		+25 °C, 10 years

\*1 Please contact us for inquiries about operating temperature, frequency tolerance, Frequency control range.

\*2 50 MHz <  $f_o$  ≤ 80 MHz : ±15 × 10<sup>-6</sup> Max.

## Frequency tolerance / Temperature range

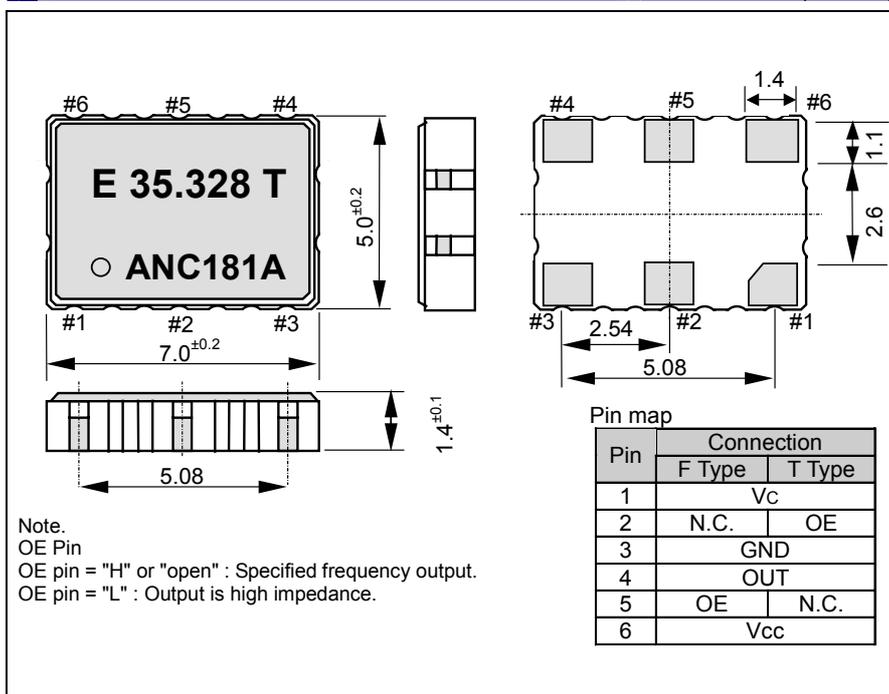
	Tolerance	Temperature range
A	±20 × 10 <sup>-6</sup>	-20 °C to +70 °C
B	±25 × 10 <sup>-6</sup>	-40 °C to +85 °C

## Frequency control range

	Frequency control range	Output frequency range
G	±50 × 10 <sup>-6</sup> Min.	70 MHz < $f_o$ ≤ 80 MHz (3.3 V) 41 MHz < $f_o$ ≤ 80 MHz (5.0V)
K	±75 × 10 <sup>-6</sup> Min.	41 MHz < $f_o$ ≤ 70 MHz (3.3V)
N	±100 × 10 <sup>-6</sup> Min.	1 MHz ≤ $f_o$ ≤ 41 MHz

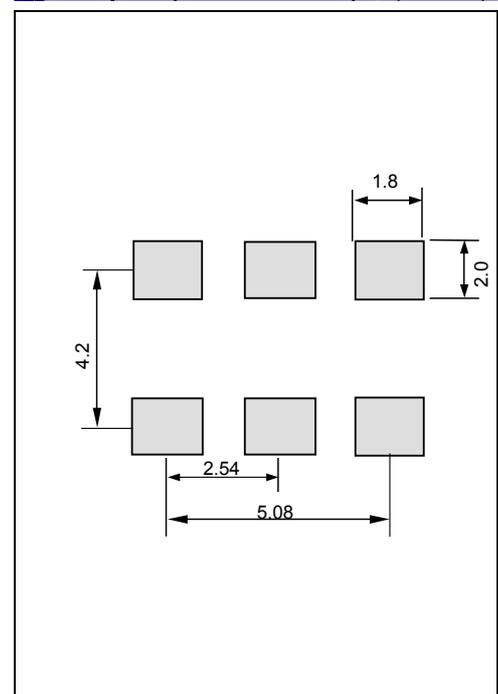
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)



VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

TCO-291B / C Series

- Frequency range : 8 MHz to 125 MHz
- Supply voltage : 3.3 V, 5.0 V
- Frequency control range:  $\pm 100 \times 10^{-6}$
- Features : Wide frequency control range  
: Fundamental mode oscillator with HFF-XTAL ( $f_0 \geq 60\text{MHz}$ )
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



Actual size



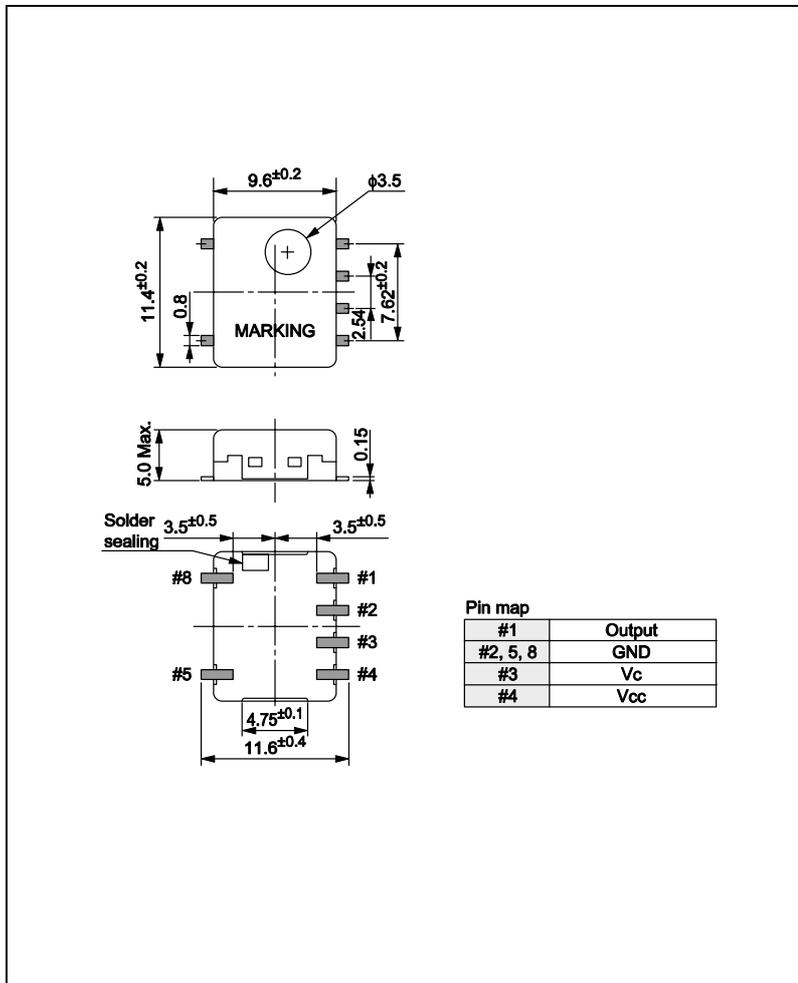
Specifications (characteristics)

Item	Symbol	TCO-291B	TCO-291C	TCO-291B2	TCO-291C2
Output frequency range	fo	8.000 MHz to 78.000 MHz			8.000 MHz to 125.000 MHz
Standard frequency		12.288 MHz, 16.384 MHz, 24.576 MHz, 32.768 MHz, 44.736 MHz, 51.84 MHz			
Supply voltage	Vcc	5.0 V $\pm 0.25$ V			3.3 V $\pm 0.165$ V
Storage temperature range	T_stg	-40 °C to +85 °C			
Operating temperature range	T_use	-20 °C to +70 °C			
Frequency tolerance	F_tol(osc)	$\pm 35 \times 10^{-6}$ Max. / -20 °C to +70 °C			
Current consumption	Icc	40 mA Max.			
Frequency control range	Fcont	$\pm 100 \times 10^{-6}$ Min. Vc = 2.5 V $\pm 2$ V		$\pm 100 \times 10^{-6}$ Min. Vc = 1.65 V $\pm 1.65$ V	
Input resistance	Rin	100 k $\Omega$ Min.(DC level)			
Frequency change polarity	—	Positive slope			
Output load condition(TTL)	L_TTL	2 TTL Max.	—	2 TTL Max.	—
Output load condition(CMOS)	L_CMOS	—	15 pF Max.	—	15 pF Max.
Oscillation start up time	tosc	10 ms Max. *1			
Frequency aging	F_aging	$\pm 5 \times 10^{-6}$ / year Max. (+25 °C, First year)			

\*1 Time at minimum supply voltage to be 0 s.

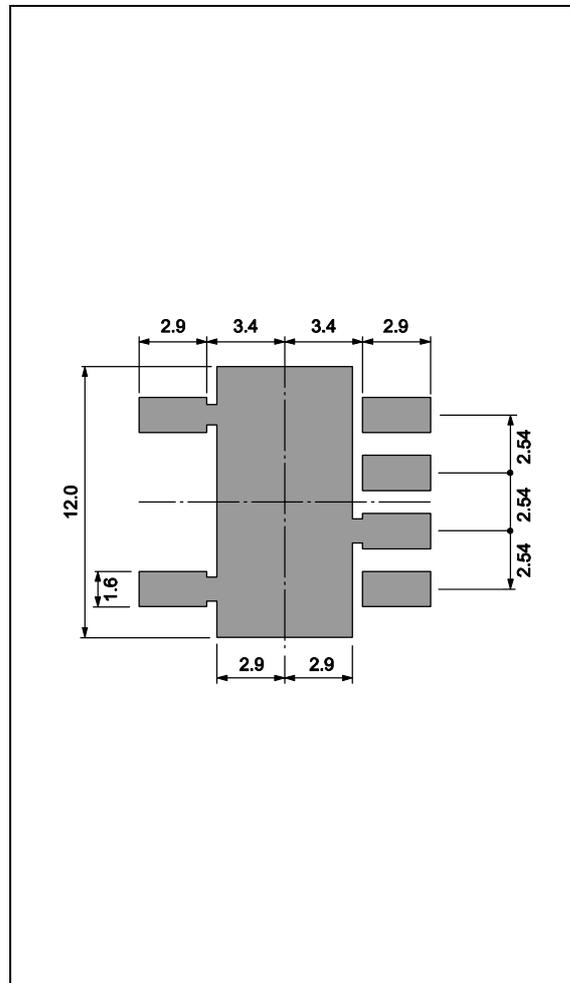
External dimensions

(Unit:mm)



Footprint (Recommended)

(Unit:mm)



## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## TCO-291J / X

- Frequency range : 60 MHz to 230 MHz
- Supply voltage : 3.3 V
- Frequency control range:  $\pm 100 \times 10^{-6}$
- Features : Wide frequency control range
- : Fundamental mode oscillator with HFF-XTAL
- : Hermetic double-sealed metal package
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



Actual size



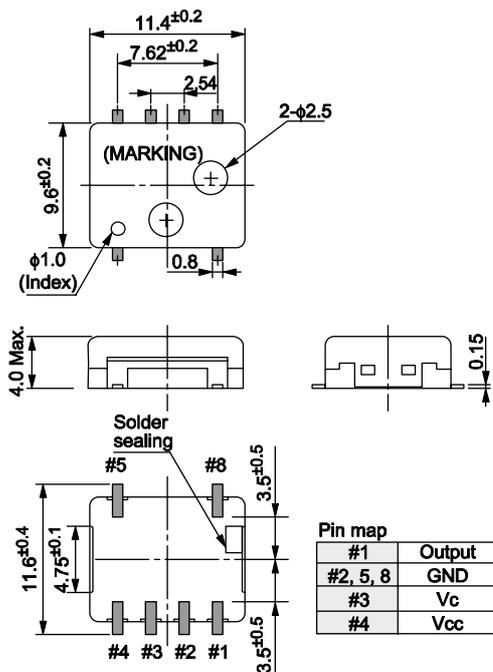
## Specifications (characteristics)

Item	Symbol	TCO-291J		TCO-291X
		Output frequency range	60.000 MHz to 230.000 MHz	
Standard frequency	$f_o$	77.760 MHz, 155.520 MHz		
Supply voltage	$V_{cc}$	5.0 V $\pm 0.25$ V	3.3 V $\pm 0.165$ V	3.3 V $\pm 0.165$ V
Storage temperature range	$T_{stg}$	-40 °C to +85 °C		
Operating temperature range	$T_{use}$	-40 °C to +85 °C		
Frequency tolerance	$F_{tol(osc)}$	$\pm 35 \times 10^{-6}$ Max. / -40 °C to +85 °C		
Current consumption	$I_{cc}$	30 mA Max.		65 mA Max
Frequency control range	$F_{cont}$	$\pm 100 \times 10^{-6}$ Min. $V_c = 2.5$ V $\pm 2$ V	$\pm 100 \times 10^{-6}$ Min. $V_c = 1.65$ V $\pm 1.65$ V	$\pm 100 \times 10^{-6}$ Min. $V_c = 1.65$ V $\pm 1.65$ V
Input resistance	$R_{in}$	100 k $\Omega$ Min. (DC level)		
Frequency change polarity	—	Positive slope		
Output load condition	—	50 $\Omega$ (0 dBm Min.)		LV-PECL
Oscillation start up time	$t_{osc}$	10 ms Max. *1		
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max. (+25 °C, First year)		

\*1 Time at minimum supply voltage to be 0 s.

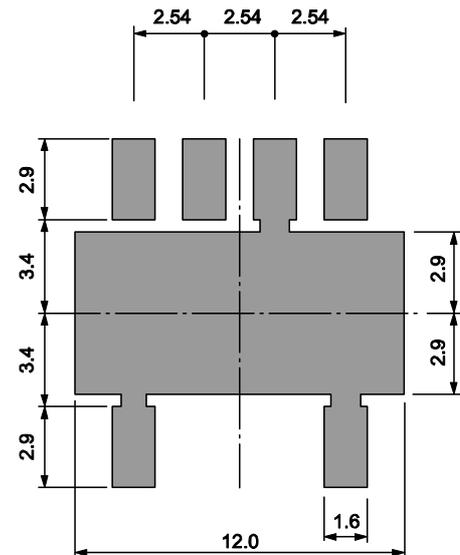
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)



VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

TCO-293 Series

- Frequency range : 60 MHz to 800 MHz
- Supply voltage : 3.3 V, 5.0 V, -5.2V
- Frequency control range:  $\pm 100 \times 10^{-6}$
- Features : Wide frequency control range  
: With HFF-XTAL technology  
: Fundamental oscillation (60MHz to 230MHz)  
: Multiplier oscillation (230MHz to 800MHz)
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



Actual size



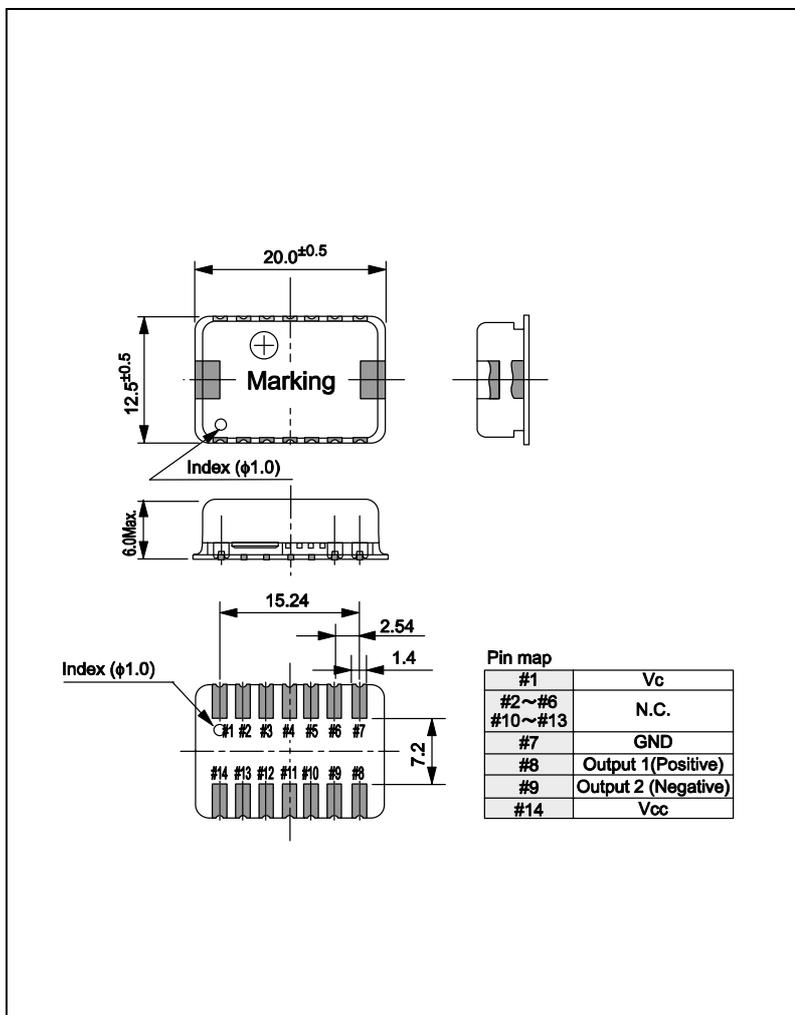
Specifications (characteristics)

Item	Symbol	TCO-293A	TCO-293B	TCO-293C	TCO-293D
Output frequency range	fo	60.000 MHz to 800.000 MHz			
Standard frequency		155.52 MHz, 166.6286 MHz, 622.08 MHz, 666 MHz, 5143 MHz			155.520 MHz
Supply voltage	Vcc	3.3 V $\pm 0.165$ V	5.0 V $\pm 0.25$ V	-5.2 V $\pm 0.26$ V	3.3 V $\pm 0.165$ V
Storage temperature range	T_stg	-40 °C to +85 °C			
Operating temperature range	T_use	-40 °C to +85 °C			
Frequency tolerance	F_tol(osc)	$\pm 35 \times 10^{-6}$ Max. / -40 °C to +85 °C			
Current consumption	Icc	65 mA Max.			40 mA Max.
Frequency control range	Fcont	$\pm 100 \times 10^{-6}$ Min. Vc= 1.65 V $\pm 1.65$ V	$\pm 100 \times 10^{-6}$ Min. Vc= 2.5 V $\pm 2$ V	$\pm 100 \times 10^{-6}$ Min. Vc= 2.5 V $\pm 2$ V	$\pm 100 \times 10^{-6}$ Min. Vc= 1.65 V $\pm 1.65$ V
Input resistance	Rin	100 k $\Omega$ Min.(DC level)			
Frequency change polarity	—	Positive slope			
Output load condition	—	LV-PECL	PECL	ECL	LV-DS
Oscillation start up time	tosc	10 ms Max. *1			
Frequency aging	F_aging	$\pm 5 \times 10^{-6}$ / year Max. (+25 °C, First year)			

\*1 Time at minimum supply voltage to be 0 s.

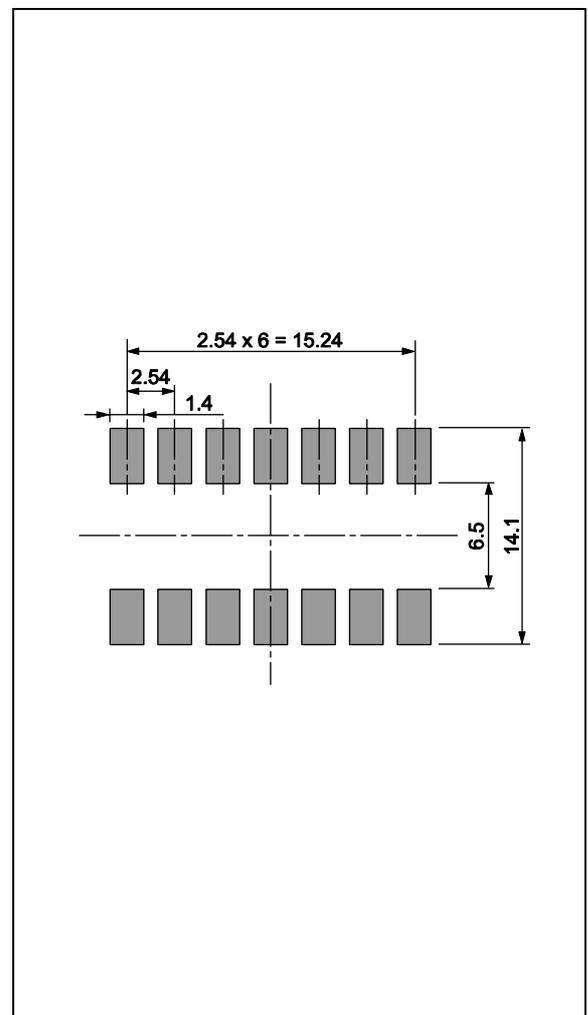
External dimensions

(Unit:mm)



Footprint (Recommended)

(Unit:mm)



## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## TCO-294J

- Frequency range : 100 MHz to 690 MHz
- Supply voltage : 3.3 V
- Frequency control range:  $\pm 100 \times 10^{-6}$
- Features : Wide frequency control range
- : With HFF-XTAL technology
- : Fundamental oscillation (60MHz to 230MHz)
- : Multiplier oscillation (230MHz to 800MHz)
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



Actual size

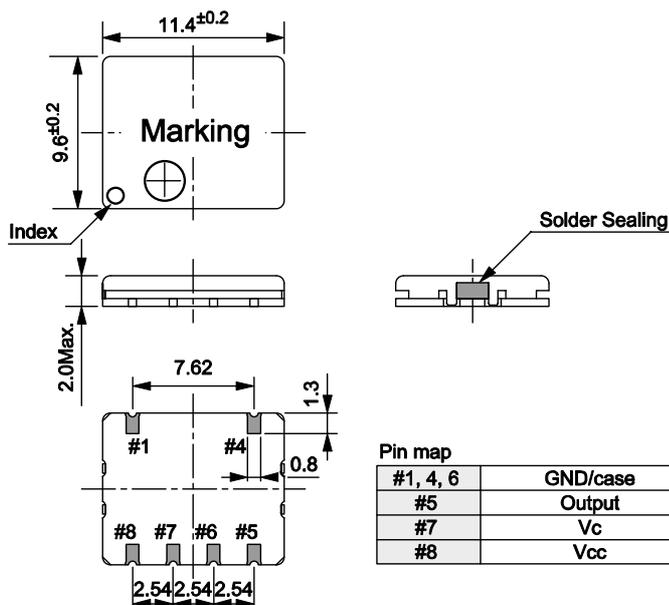


## Specifications (characteristics)

Item	Symbol	TCO-294J	Remarks
Output frequency range	fo	100.000 MHz to 690.000 MHz	
		622.08 MHz, 666.5143 MHz	Standard frequency
Supply voltage	Vcc	3.3 V $\pm 0.165$ V	
Storage temperature range	T_stg	-40 °C to +85 °C	
Operating temperature range	T_use	-40 °C to +85 °C	
Frequency tolerance	F_tol(osc)	$\pm 35 \times 10^{-6}$ Max.	-40 °C to +85 °C
Current consumption	Icc	40 mA Max.	
Frequency control range	Fcont	$\pm 100 \times 10^{-6}$ Min.	Vc= 1.65V $\pm 1.65$ V
Input resistance	Rin	100 k $\Omega$ Min.	DC level
Frequency change polarity	—	Positive slope	Vc= 0 to 3.3 V
Output load condition	RL	50 $\Omega$ (0 dBm Min.)	
Oscillation start up time	tosc	10 ms Max.	Time at minimum supply voltage to be 0 s.
Frequency aging	F_aging	$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, First year

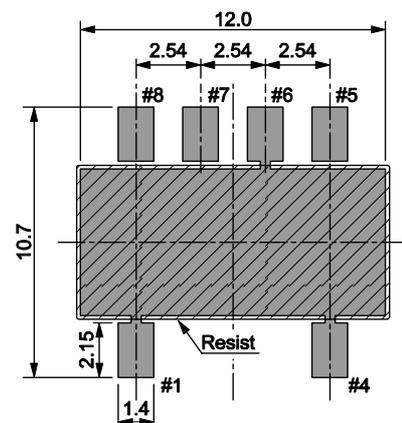
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)



VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

TCO-296 Series

- Frequency range : 100 MHz to 690 MHz
- Supply voltage : 3.3 V
- Frequency control range:  $\pm 100 \times 10^{-6}$
- Features : Wide frequency control range
- : With HFF-XTAL technology
- : Fundamental oscillation (60MHz to 230MHz)
- : Multiplier oscillation (230MHz to 800MHz)
- Function : Output enable(OE) (TCO-296X)
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



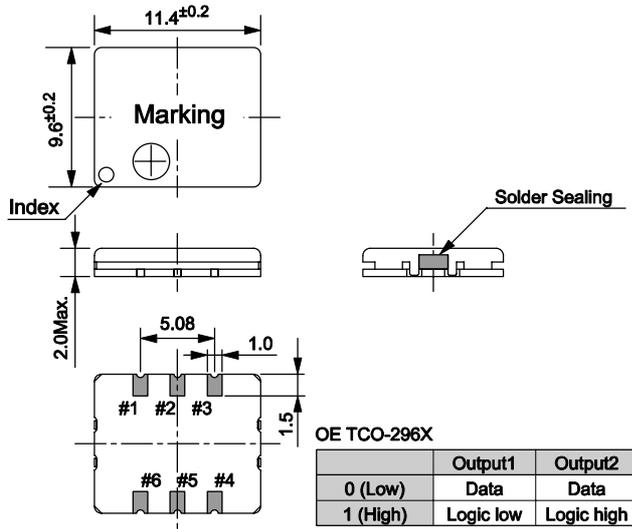
Actual size



Specifications (characteristics)

Item	Symbol	TCO-296A	TCO-296J	TCO-296X	Remarks
Output frequency range	fo	100.000 MHz to 690.000 MHz			Standard frequency
		622.08 MHz, 666.5143 MHz			
Supply voltage	Vcc	3.3 V $\pm 0.165$ V			
Storage temperature range	T_stg	-40 °C to +85 °C			
Operating temperature range	T_use	-40 °C to +85 °C			
Frequency tolerance	F_tol(osc)	$\pm 35 \times 10^{-6}$ Max.			-40 °C to +85 °C
Current consumption	Icc	70 mA Max.	40 mA Max.	85 mA Max.	
Output enable (OE)	—	—	—	OE	
Frequency control range	Fcont	$\pm 100 \times 10^{-6}$ Min.			Vc= 1.65 V $\pm 1.65$ V
Input resistance	Rin	100 k $\Omega$ Min.			DC level
Frequency change polarity	—	Positive slope			Vc= 0 to 3.3 V
Output load condition	—	LV-PECL	50 $\Omega$ (0 dBm Min.)	LV-PECL	
Oscillation start up time	tosc	10 ms Max.			Time at minimum supply voltage to be 0 s.
Frequency aging	F_aging	$\pm 5 \times 10^{-6}$ / year Max.			+25 °C, First year

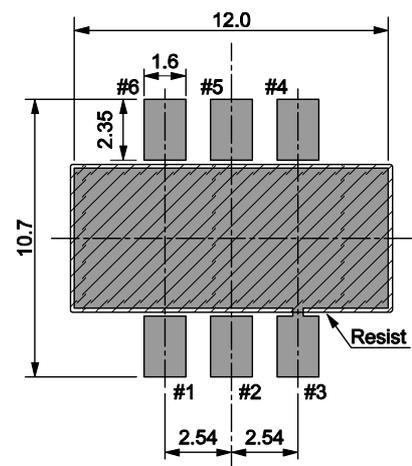
External dimensions (Unit:mm)



Pin map

	TCO-296A	TCO-296J	TCO-296X
#1		Vc	
#2	N.C.		OE
#3		GND/case	
#4	Output 2 (Negative)	Output	Output 2 (Negative)
#5	Output 1 (Positive)	N.C.	Output 1 (Positive)
#6		Vcc	

Footprint (Recommended) (Unit:mm)



## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## TCO-2000 / 2100 Series

- Frequency range : 8 MHz to 125 MHz
- Supply voltage : 3.3 V or 5.0 V
- Frequency control range :  $\pm 100 \times 10^{-6}$
- Features : Wide frequency control range  
: Fundamental mode oscillator with HFF-XTAL (fo $\geq$ 60MHz)
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



Actual size



## Specifications (characteristics)

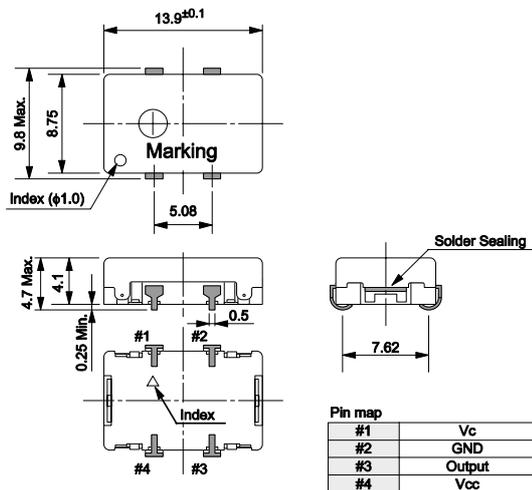
Item	Symbol	TCO-2001A	TCO-2003A	TCO-2002A	TCO-2004A
		TCO-2101A	TCO-2103A	TCO-2102A	TCO-2104A
Output frequency range	fo	8.000 MHz to 78.000 MHz		8.000 MHz to 125.000 MHz	
Standard frequency		32.768 MHz, 44.736 MHz, 51.84 MHz, 77.76 MHz			
Supply voltage	Vcc	5.0 V $\pm 0.25$ V		3.3 V $\pm 0.165$ V	
Storage temperature range	T_stg	-40 °C to +85 °C			
Operating temperature range	T_use	-40 °C to +85 °C			
Frequency tolerance	F_tol(osc)	$\pm 35 \times 10^{-6}$ Max. / -40 °C to +85 °C			
Current consumption	Icc	50 mA Max.			
Frequency control range	Fcont	$\pm 100 \times 10^{-6}$ Min. Vc=2.5 V $\pm 2$ V		$\pm 100 \times 10^{-6}$ Min. Vc=1.65 V $\pm 1.65$ V	
Input resistance	Rin	100 k $\Omega$ Min. (DC level)			
Frequency change polarity	—	Positive slope			
Output load condition (TTL)	L_TTL	2 TTL Max.	—	2 TTL Max.	—
Output load condition (CMOS)	L_CMOS	—	15 pF Max.	—	15 pF Max.
Oscillation start up time	tosc	10 ms Max. <sup>*1</sup>			
Frequency aging	F_aging	$\pm 5 \times 10^{-6}$ / year Max. (+25 °C, First year)			

\*1 Time at minimum supply voltage to be 0 s.

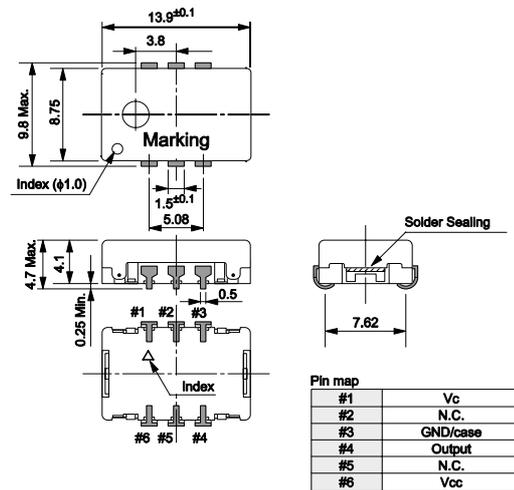
## External dimensions

(Unit:mm)

## ● TCO-2001A / 2002A / 2003A / 2004A



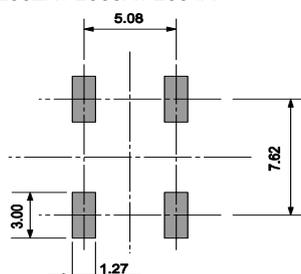
## ● TCO-2101A / 2102A / 2103A / 2104A



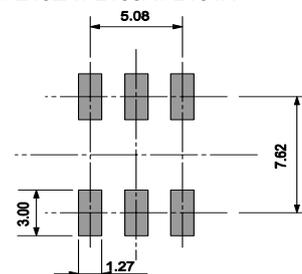
## Footprint (Recommended)

(Unit:mm)

## ● TCO-2001A / 2002A / 2003A / 2004A



## ● TCO-2101A / 2102A / 2103A / 2104A



VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

TCO-2106 / 2107

- Frequency range : 1 MHz to 80 MHz
- Supply voltage : 3.3 V
- Frequency control range:  $\pm 100 \times 10^{-6}$
- Features : Wide frequency control range
- : Fundamental mode oscillator with HFF-XTAL ( $f_0 \geq 60$  MHz)
- Function : Output enable(OE)
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



Actual size

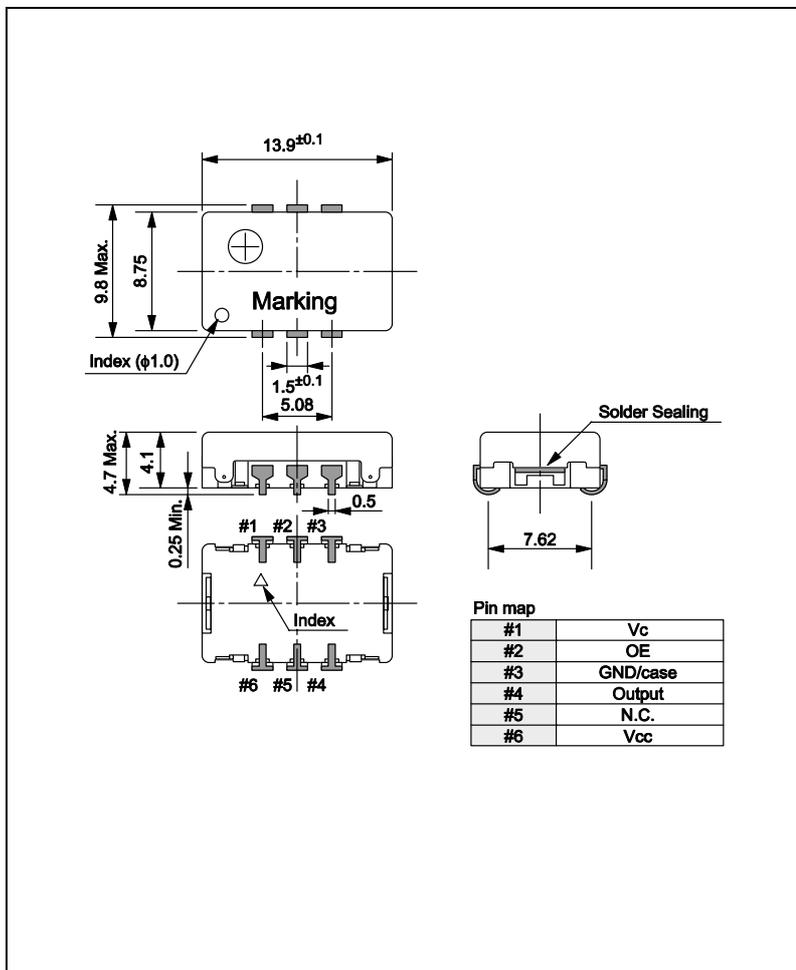


Specifications (characteristics)

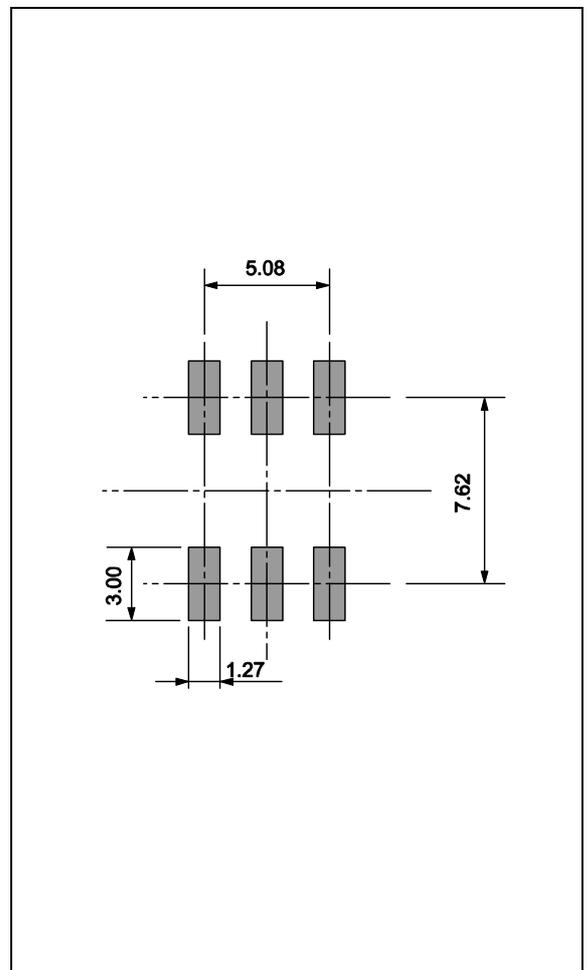
Item	Symbol	TCO-2106	TCO-2107	Remarks
Output frequency range	fo	1.000 MHz to 80.000 MHz		Standard frequency
		32.768 MHz, 44.736 MHz, 51.84 MHz, 77.76 MHz		
Supply voltage	Vcc	3.3 V $\pm 0.165$ V		
Storage temperature range	T_stg	-40 °C to +85 °C		
Operating temperature range	T_use	-40 °C to +85 °C		
Frequency tolerance	F_tol(osc)	$\pm 35 \times 10^{-6}$ Max.		-40 °C to +85 °C
Current consumption	Icc	30 mA Max.		
Frequency control range	Fcont	$\pm 100 \times 10^{-6}$ Min.		Vc= 1.65 V $\pm 1.65$ V
Input resistance	Rin	100 k $\Omega$ Min.		DC level
Frequency change polarity	—	Positive slope		Vc= 0 to 3.3 V
Output load condition (TTL)	L_TTL	2 TTL Max.	—	
Output load condition (CMOS)	L_CMOS	—	15 pF Max.	
Oscillation start up time	tosc	10 ms Max. *1		Time at minimum supply voltage to be 0 s.
Frequency aging	F_aging	$\pm 5 \times 10^{-6}$ / year Max.		+25 °C, First year

\*1 Time at minimum supply voltage to be 0 s.

External dimensions (Unit:mm)



Footprint (Recommended) (Unit:mm)



## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## TCO-2110 Series

- Frequency range : 60 MHz to 800 MHz
- Supply voltage : 3.3 V, 5.0 V, -5.2V
- Frequency control range:  $\pm 100 \times 10^{-6}$
- Features : Wide frequency control range  
: With HFF-XTAL technology  
Fundamental oscillation (60MHz to 230MHz)  
Multiplier oscillation (230MHz to 800MHz)
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



Actual size



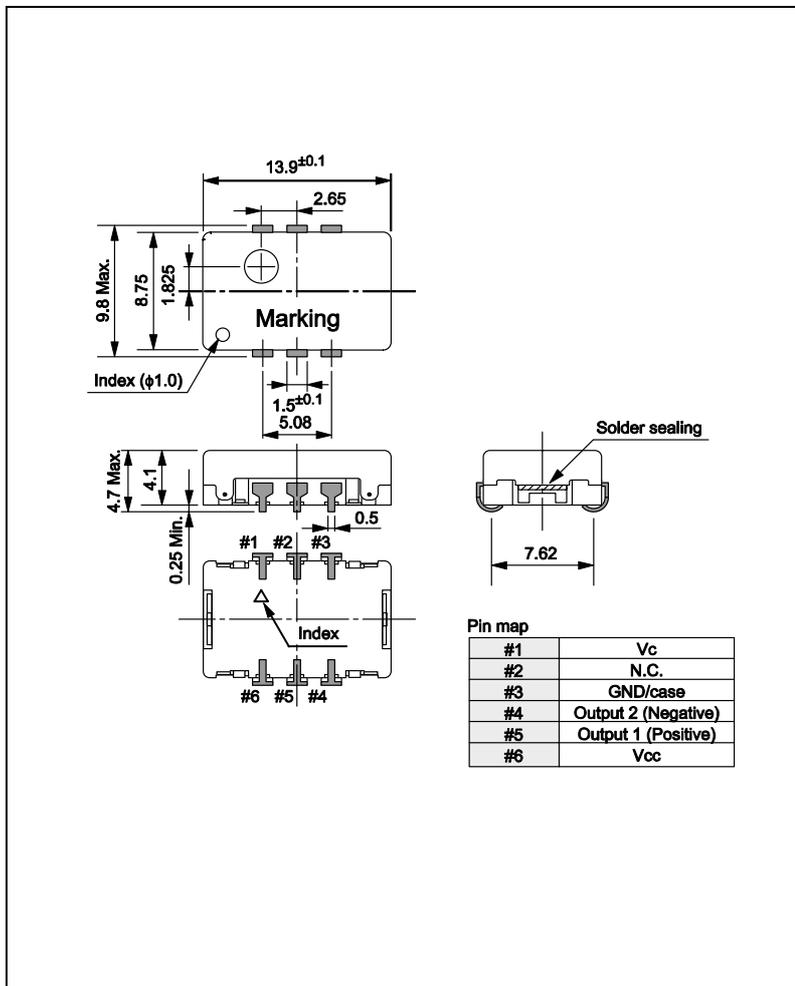
## Specifications (characteristics)

Item	Symbol	TCO-2111	TCO-2112	TCO-2113	TCO-2114
Output frequency range		60.000 MHz to 800.000 MHz			
Standard frequency	$f_o$	77.7600 MHz, 155.52 MHz, 156.2500 MHz, 166.6286 MHz, 622.08 MHz, 666.5143 MHz			155.520 MHz
Supply voltage	$V_{cc}$	3.3 V $\pm 0.165$ V	5.0 V $\pm 0.25$ V	-5.2 V $\pm 0.26$ V	3.3 V $\pm 0.165$ V
Storage temperature range	$T_{stg}$	-40 °C to +85 °C			
Operating temperature range	$T_{use}$	-40 °C to +85 °C			
Frequency tolerance	$F_{tol}(osc)$	$\pm 35 \times 10^{-6}$ Max. / -40 °C to +85 °C			
Current consumption	$I_{cc}$	65 mA Max.			40 mA Max.
Frequency control range	$F_{cont}$	$\pm 100 \times 10^{-6}$ Min. $V_c = 1.65$ V $\pm 1.65$ V	$\pm 100 \times 10^{-6}$ Min. $V_c = 2.5$ V $\pm 2$ V	$\pm 100 \times 10^{-6}$ Min. $V_c = 2.5$ V $\pm 2$ V	$\pm 100 \times 10^{-6}$ Min. $V_c = 1.65$ V $\pm 1.65$ V
Input resistance	$R_{in}$	100 k $\Omega$ Min. (DC level)			
Frequency change polarity	—	Positive slope			
Output level	—	LV-PECL	PECL	ECL	LV-DS
Oscillation start up time	$t_{osc}$	10 ms Max. *1			
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max. (+25 °C, First year)			

\*1 Time at minimum supply voltage to be 0 s.

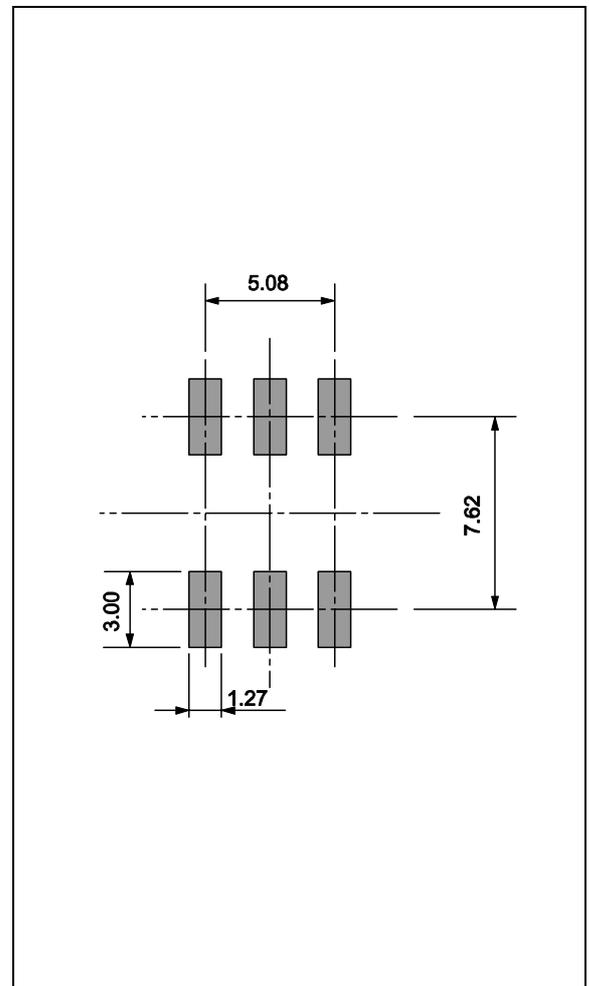
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)



VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

TCO-2131

- Frequency range : 60 MHz to 700 MHz
- Supply voltage : 3.3 V
- Frequency control range:  $\pm 100 \times 10^{-6}$
- Features : Wide frequency control range
- : With HFF-XTAL technology
- : Fundamental oscillation (60MHz to 230MHz)
- : Multiplier oscillation (230MHz to 700MHz)
- Function : Output enable(OE)
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



Actual size

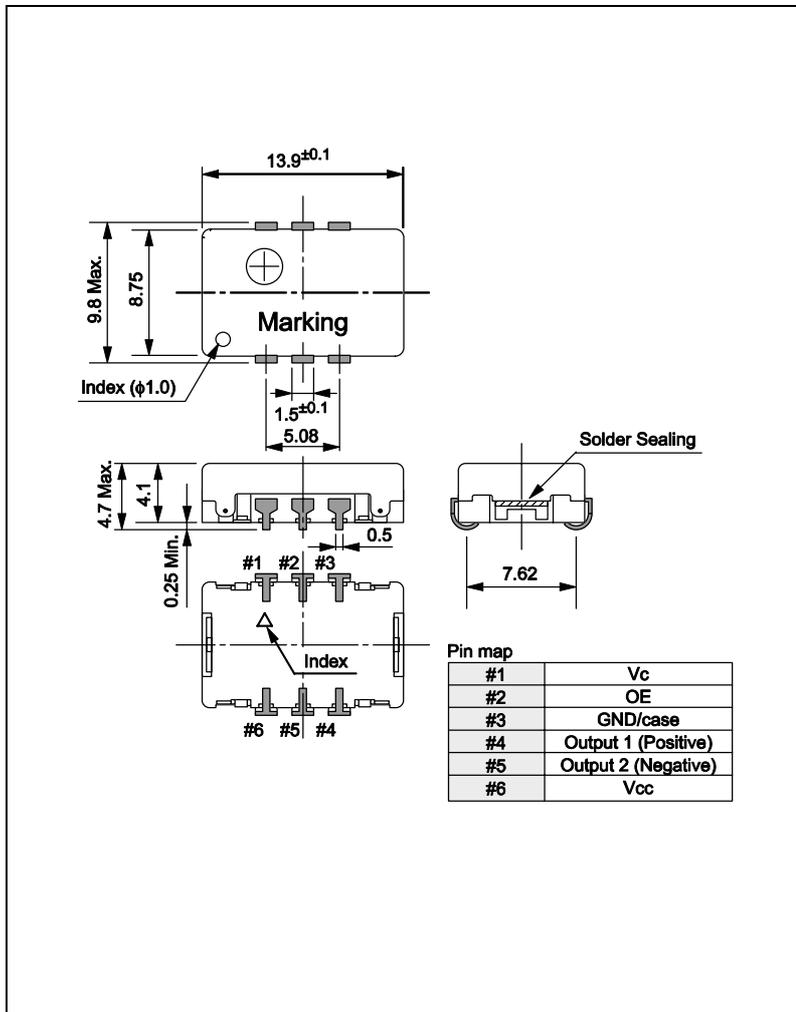


Specifications (characteristics)

Item	Symbol	Specifications	Remarks
Output frequency range	fo	60.000 MHz to 700.000 MHz	Standard frequency
		77.76 MHz, 155.52 MHz, 156.25 MHz, 166.6286 MHz, 622.08 MHz, 666.5143 MHz	
Supply voltage	Vcc	3.3 V $\pm 0.165$ V	
Storage temperature range	T_stg	-40 °C to +85 °C	
Operating temperature range	T_use	-40 °C to +85 °C	
Frequency tolerance	F_tol(osc)	$\pm 35 \times 10^{-6}$ Max.	-40 °C to +85 °C
Current consumption	Icc	75 mA Max.	
Frequency control range	Fcont	$\pm 100 \times 10^{-6}$ Min.	Vc= 1.65 V $\pm 1.65$ V
Input resistance	Rin	100 k $\Omega$ Min.	DC level
Frequency change polarity	—	Positive slope	Vc= 0 to 3.3 V
Output load condition	—	LV-PECL	
Oscillation start up time	tosc	10 ms Max.	Time at minimum supply voltage to be 0 s.
Frequency aging	F_aging	$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, First year

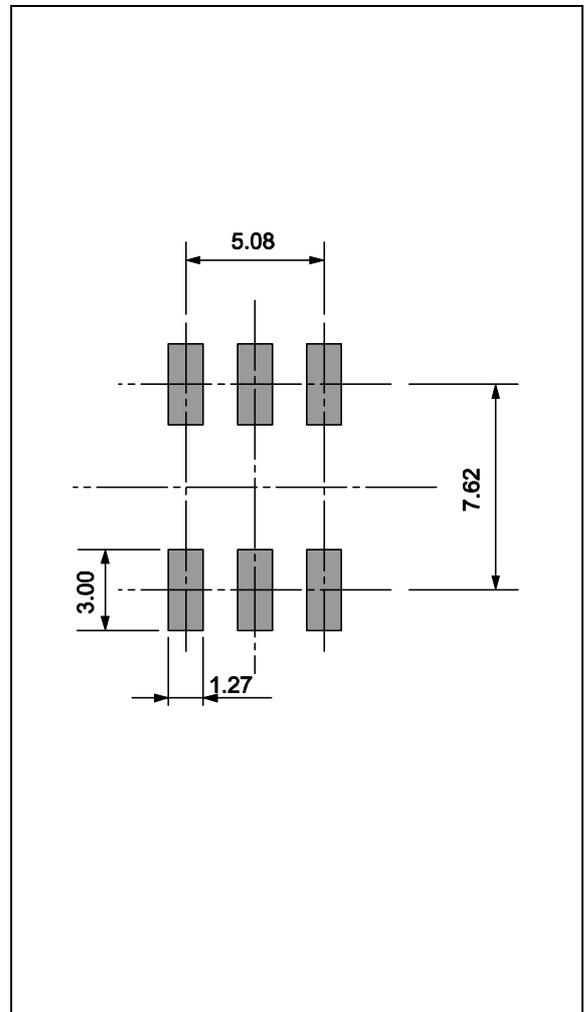
External dimensions

(Unit:mm)



Footprint (Recommended)

(Unit:mm)



VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

TCO-2152

- Frequency range : 77 MHz to 230 MHz
- Supply voltage : 3.3 V
- Frequency control range:  $\pm 100 \times 10^{-6}$
- Features : Wide frequency control range
- : With HFF-XTAL technology
- : Fundamental oscillation
- Function : Output enable(OE)
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



Actual size

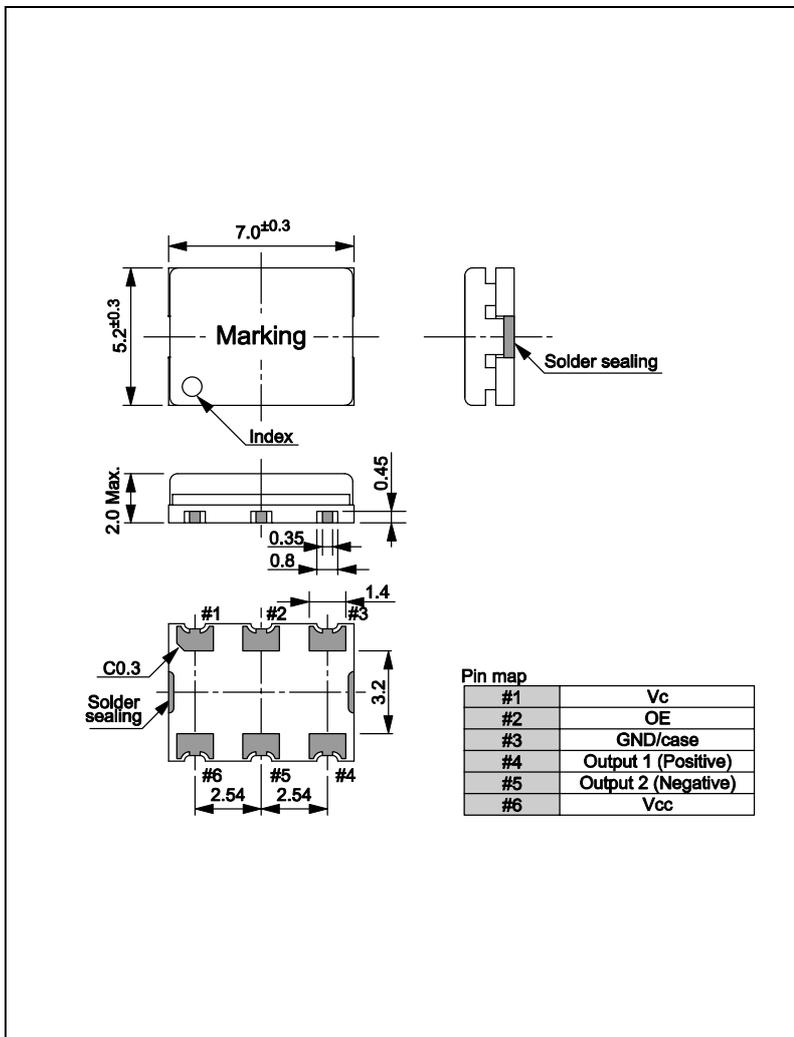


Specifications (characteristics)

Item	Symbol	TCO-2152	Remarks
Output frequency range	fo	77.000 MHz to 230.000 MHz	
		77.760 MHz, 155.520 MHz	Standard frequency
Supply voltage	Vcc	3.3 V $\pm 0.165$ V	
Storage temperature range	T_stg	-40 °C to +85 °C	
Operating temperature range	T_use	-40 °C to +85 °C	
Frequency tolerance	F_tol(osc)	$\pm 35 \times 10^{-6}$ Max.	-40 °C to +85 °C
Current consumption	Icc	70 mA Max.	
Frequency control range	Fcont	$\pm 100 \times 10^{-6}$ Min.	Vc= 1.65V $\pm 1.65$ V
Input resistance	Rin	100 k $\Omega$ Min.	DC level
Frequency change polarity	—	Positive slope	Vc= 0 to 3.3 V
Output load condition	—	LV-PECL	
Oscillation start up time	tosc	10 ms Max.	Time at minimum supply voltage to be 0 s.
Frequency aging	F_aging	$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, First year

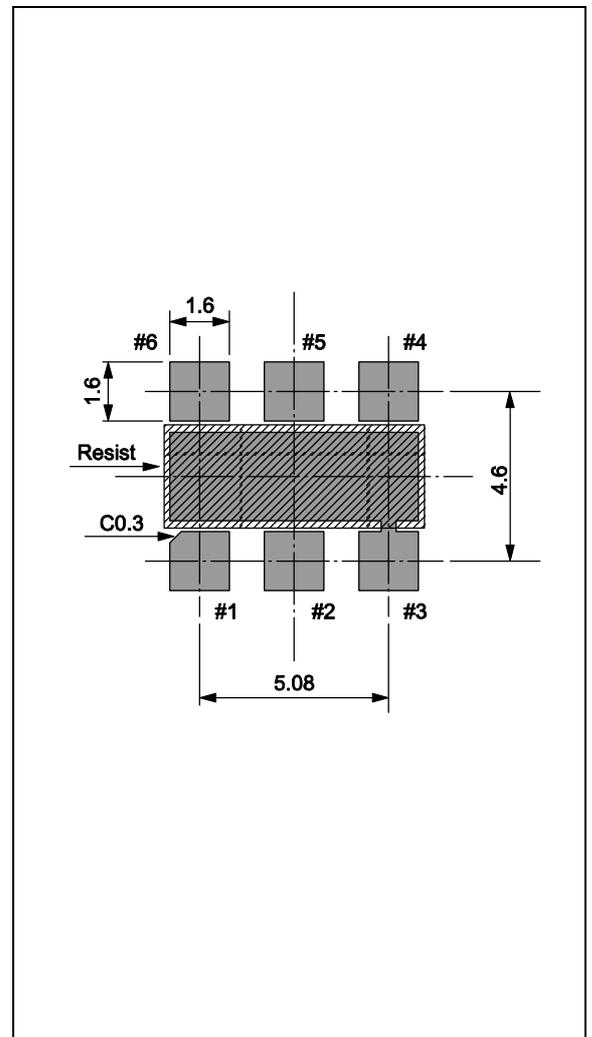
External dimensions

(Unit:mm)



Footprint (Recommended)

(Unit:mm)



## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## TCO-726BVX / DVX

- Frequency range : 1.5 MHz to 34 MHz
- Supply voltage : 5.0 V
- Frequency control range:  $\pm 100 \times 10^{-6}$
- Thickness : 5 mm Max.
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



Actual size



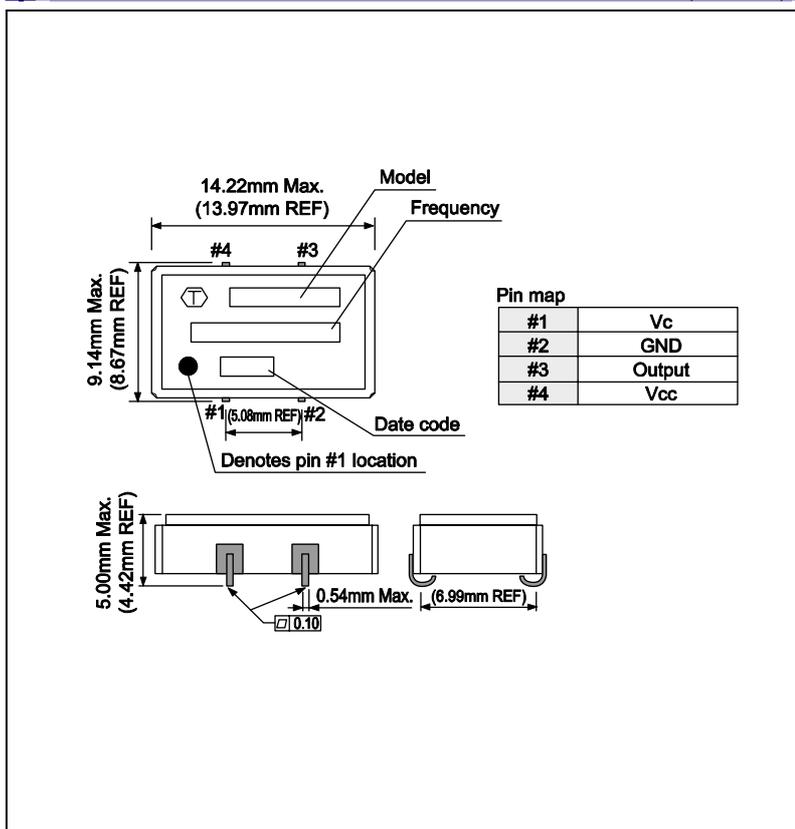
## Specifications (characteristics)

Item	Symbol	TCO-726BVX	TCO-726DVX	Remarks
Output frequency range	$f_o$	1.500 MHz to 34.000 MHz		Please contact us for inquiries regarding the available frequencies.
Supply voltage	V <sub>cc</sub>	5.0 V $\pm$ 0.25 V		
Storage temperature range	T <sub>stg</sub>	-40 °C to +85 °C		
Operating temperature range	T <sub>use</sub>	-20 °C to +70 °C		
Frequency tolerance	F <sub>tol(osc)</sub>	$\pm 50 \times 10^{-6}$ Max.		-20 °C to +70 °C
Current consumption	I <sub>cc</sub>	35 mA Max.		No load condition.
Frequency control range	F <sub>cont</sub>	$\pm 100 \times 10^{-6}$ Min.		V <sub>c</sub> = 2.5V $\pm$ 2V
Input resistance	R <sub>in</sub>	100 k $\Omega$ Min.		DC level
Frequency change polarity	—	Positive slope		V <sub>c</sub> = 0 to 5.0 V
Symmetry	SYM	40 % to 60 %		1.4 V level (TCO-726BVX) 50 % V <sub>cc</sub> level (TCO-726DVX)
High output voltage	V <sub>OH</sub>	4.0 V Min.	V <sub>cc</sub> -0.4 V Min.	
Low output voltage	V <sub>OL</sub>	0.4 V Max.	0.4 V Max.	
Output load condition (TTL)	L <sub>TTL</sub>	10 TTL Max.	—	
Output load condition (CMOS)	L <sub>CMOS</sub>	—	30 pF Max.	
Rise time / Fall time	t <sub>r</sub> / t <sub>f</sub>	15 ns Max.		0.4V to 2.4V level (TCO-726BVX) 10 % V <sub>cc</sub> to 90 % V <sub>cc</sub> level (TCO-726DVX)
Oscillation start up time	t <sub>osc</sub>	10 ms Max.		Time at minimum supply voltage to be 0 s
Frequency aging	F <sub>aging</sub>	$\pm 5 \times 10^{-6}$ / year Max.		+25 °C, V <sub>cc</sub> =5 V, First year

\* Give the V<sub>c</sub> voltage at the time of the power supply input as GND or open without fail.

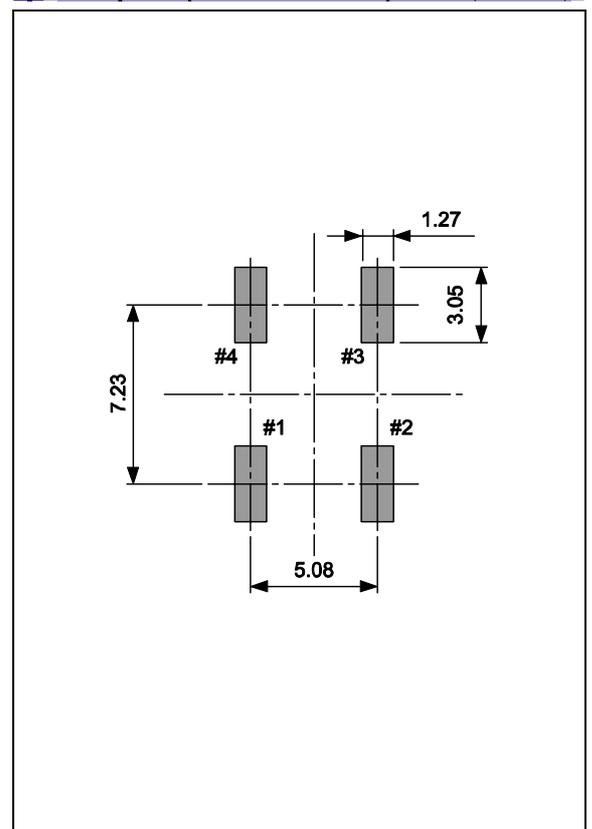
## External dimensions

(Unit :mm)



## Footprint (Recommended)

(Unit :mm)



## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## TCO-7026X1V2

- Frequency range : 34 MHz to 67 MHz
- Supply voltage : 3.3 V
- Frequency control range :  $\pm 100 \times 10^{-6}$
- Thickness : 5.0 mm Max.
- Function : Output enable(OE)
- Lead(Pb)-free : Contains Pb in this product exempted RoHS directive.



Actual size



## Specifications (characteristics)

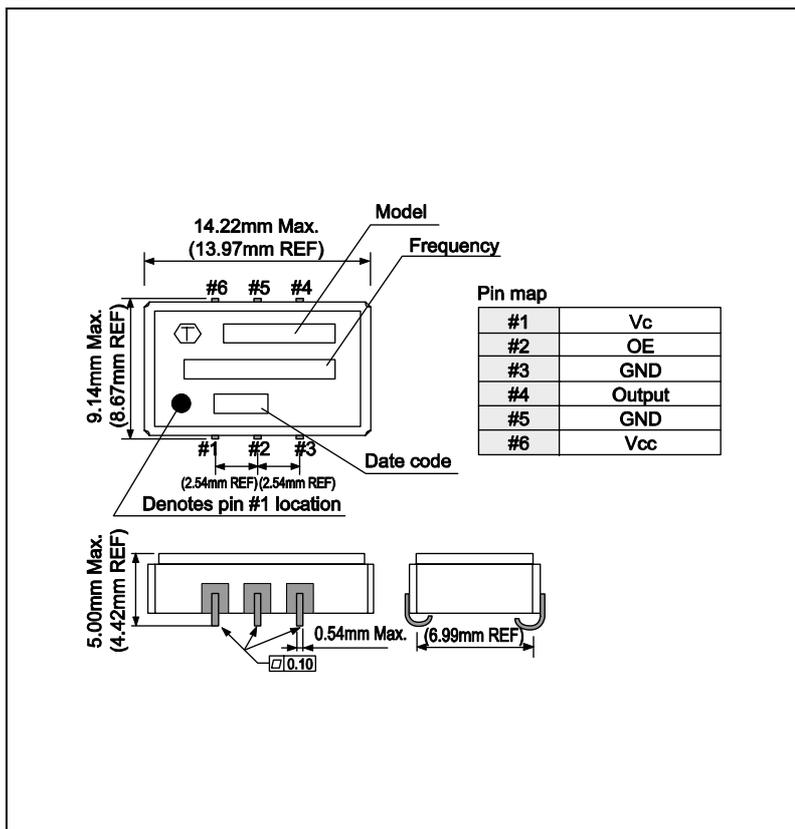
Item	Symbol	TCO-7026X1V2	Remarks
Output frequency range	$f_o$	34.000 MHz to 67.000 MHz	Please contact us for inquiries regarding available frequencies.
Supply voltage	Vcc	3.3 V $\pm 0.165$ V	
Storage temperature range	T_stg	-40 °C to +85 °C	
Operating temperature range	T_use	-20 °C to +70 °C	
Frequency tolerance	F_tol(osc)	$\pm 50 \times 10^{-6}$ Max.	-20 °C to +70 °C
Current consumption	Icc	40 mA Max.	No load condition.
Frequency control range	Fcont	$\pm 100 \times 10^{-6}$ Min.	Vc= 1.65V $\pm$ 1.65V
Input resistance	Rin	100 k $\Omega$ Min.	DC level
Frequency change polarity	—	Positive slope	Vc= 0 to 3.3 V
Symmetry	SYM	40 % to 60 %	50 % Vcc level
High output voltage	VOH	Vcc-0.4 V Min.	
Low output voltage	VOL	0.4 V Max.	
Output load condition (CMOS)	L_CMOS	15 pF Max.	
Output enable / disable input voltage	V <sub>IH</sub>	70 % Vcc Min.	V <sub>IH</sub> or OPEN : Enable
	V <sub>IL</sub>	30 % Vcc Max.	V <sub>IL</sub> or GND : Disable
Rise time / Fall time	t <sub>r</sub> / t <sub>f</sub>	15 ns Max.	10 % Vcc to 90 % Vcc level
Oscillation start up time	t <sub>osc</sub>	10 ms Max.	Time at minimum supply voltage to be 0 s
Frequency aging	F_aging	$\pm 5 \times 10^{-6}$ / year Max.	+25 °C, Vcc=3.3 V, First year

\*1 Rise time (or 3.15 V) of Vcc > 150  $\mu$ s.

\* Give the Vc voltage at the time of the power supply input as GND or open without fail.

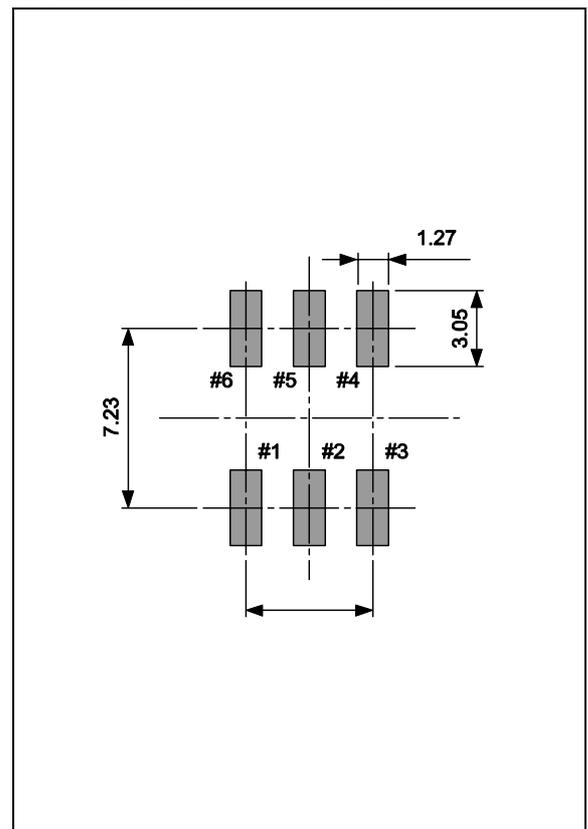
## External dimensions

(Unit :mm)



## Footprint (Recommended)

(Unit :mm)



## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## VG-4030JA

- Frequency range : 2 MHz to 28.63636 MHz
- Supply voltage : 3.3 V
- Frequency control range :  $150 \times 10^{-6}$  or  $180 \times 10^{-6}$  /  $V_c=0$  to 3.0 V
- Thickness : 4.7 mm Max.
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive



Actual size

 VG4030 DVK  
 27.0000M  
 E 9357A

## Specifications (characteristics)

Item	Symbol	Specifications		Remarks
		DVK		
Output frequency range	$f_o$	2.000 MHz to 28.63636 MHz		Please contact us for inquiries regarding available frequencies.
Supply voltage	$V_{cc}$	3.3 V $\pm$ 0.17 V		
Temperature range	Storage temperature	$T_{stg}$ -55 °C to +125 °C		Stored as bare product after unpacking
	Operating temperature	$T_{use}$ -20 °C to +70 °C		
Frequency tolerance	$F_{tol(osc)}$	$\pm 37 \times 10^{-6}$ Max.		$V_c=1.8$ V
Current consumption	$I_{cc}$	18 mA Max.		No load condition
Frequency control range	$F_{cont}$	$150 \times 10^{-6}$ or $180 \times 10^{-6}$		$V_c=0$ to 3.0 V (Please contact us.)
Input resistance	$R_{in}$	10 M $\Omega$ Min.		DC level
Frequency change polarity		Positive polarity		$V_c=0$ to 3.0 V
Symmetry	SYM	40 % to 60 %		CMOS load: 50 % $V_{cc}$ level
High output voltage	$V_{OH}$	$V_{cc}-0.4$ V Min.		$I_{OH}=-0.8$ mA
Low output voltage	$V_{OL}$	0.4 V Max.		$I_{OL}=3.2$ mA
Output load condition (CMOS)	$L_{CMOS}$	30 pF Max.		CMOS load
Output rise and fall time	$t_r / t_f$	6 ns Max.		CMOS load: 20 % $V_{cc}$ to 80 % $V_{cc}$ level
Oscillation start up time	$t_{osc}$	10 ms Max.		Time at minimum supply voltage to be 0 s
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max.		+25 °C, $V_{cc}=3.3$ V, First year

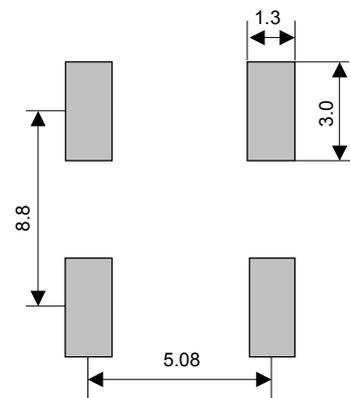
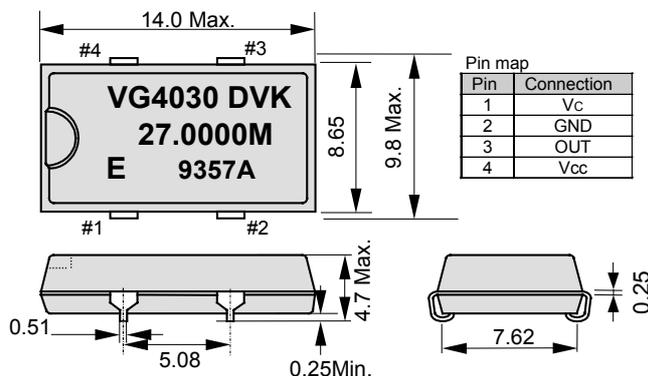
Note: Give the  $V_c$  voltage at the time of the power supply input as GND or open without fail.

## External dimensions

(Unit:mm)

## Footprint (Recommended)

(Unit:mm)



## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO) WIDE PULL RANGE

# TCO-756BVX7 / DVX7

- Frequency range : 1.5 MHz to 40 MHz
- Supply voltage : 5.0 V
- Frequency control range:  $\pm 150 \times 10^{-6}$
- Features : Hermetic double-sealed metal package
- Lead(Pb)-free : Contains Pb in this product exempted RoHS directive.



Actual size



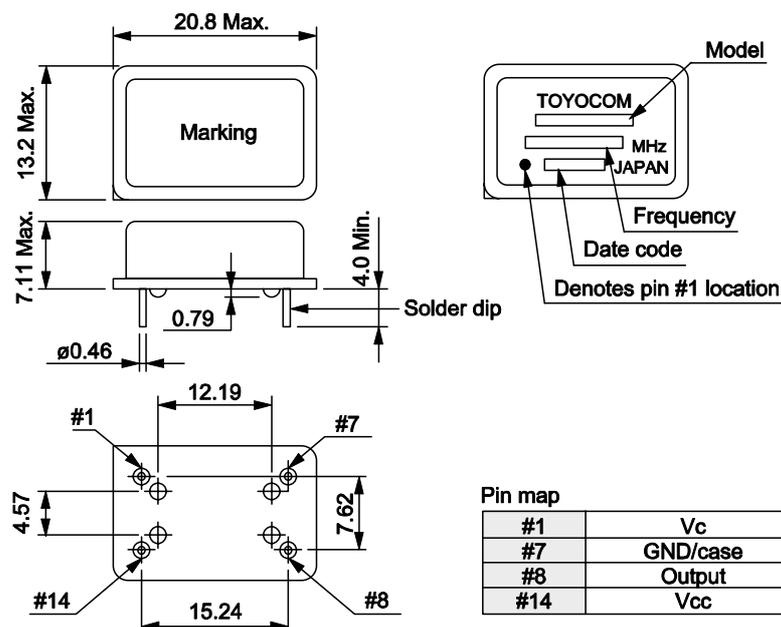
### Specifications (characteristics)

Item	Symbol	TCO-756BVX7	TCO-756DVX7	Remarks
Output frequency range	$f_o$	1.500 MHz to 40.000 MHz		Please contact us for inquiries regarding available frequencies.
Supply voltage	$V_{cc}$	5.0 V $\pm 0.25$ V		
Storage temperature range	$T_{stg}$	-40 °C to +85 °C		
Operating temperature range	$T_{use}$	0 °C to +70 °C		
Frequency tolerance	$F_{tol(osc)}$	$\pm 50 \times 10^{-6}$ Max.		0 °C to +70 °C
Current consumption	$I_{cc}$	40 mA Max.		No load condition
Frequency control range	$F_{cont}$	$\pm 150 \times 10^{-6}$ Min.		$V_c = 2.5V \pm 2.5V$
Input resistance	$R_{in}$	100 k $\Omega$ Min.		DC level
Frequency change polarity	—	Positive slope		$V_c = 0$ to 5.0 V
Symmetry	SYM	40 % to 60 %		1.4 V level (TCO-756BVX7) 50 % $V_{cc}$ level (TCO-756DVX7)
High output voltage	$V_{OH}$	4.0 V Min.	$V_{cc} - 0.4$ V Min.	
Low output voltage	$V_{OL}$	0.4 V Max.	0.4 V Max.	
Output load condition (TTL)	$L_{TTL}$	10 TTL Max.	—	
Output load condition (CMOS)	$L_{CMOS}$	—	30 pF Max.	
Rise time / Fall time	$t_r / t_f$	15 ns Max.		0.4V to 2.4V level (TCO-756BVX7) 10 % $V_{cc}$ to 90 % $V_{cc}$ level (TCO-756DVX7)
Oscillation start up time	$t_{osc}$	10 ms Max.		Time at minimum supply voltage to be 0 s
Frequency aging	$F_{aging}$	$\pm 5 \times 10^{-6}$ / year Max.		+25 °C, $V_{cc} = 5$ V, First year

\* Give the  $V_c$  voltage at the time of the power supply input as GND or open without fail.

### External dimensions

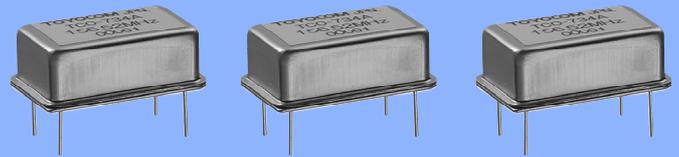
(Unit : mm)



VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

**TCO-734A**  
**TCO-735 Series**

- Frequency range : 60 MHz to 230 MHz
- Supply voltage : 3.3 V, 5.0 V, -5.2 V
- Frequency control range:  $\pm 100 \times 10^{-6}$
- Features : Wide frequency control range
- : Fundamental mode oscillator with HFF-XTAL
- : Hermetic double-sealed metal package
- Lead(Pb)-free : Contains Pb in this product exempted by RoHs directive.



Actual size



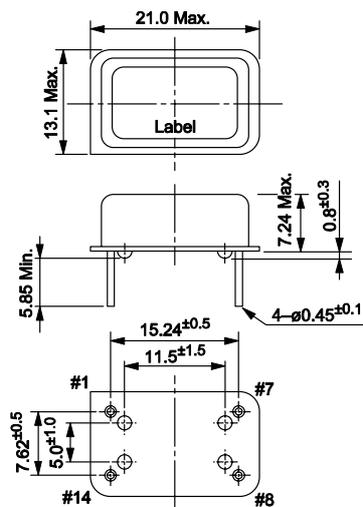
**Specifications (characteristics)**

Item	Symbol	TCO-734A	TCO-735A	TCO-735B	TCO-735C
Output frequency range	fo	60.000 MHz to 230.000 MHz			
Standard frequency		155.200 MHz			
Supply voltage	Vcc	3.3 V $\pm 0.165$ V 5.0 V $\pm 0.25$ V	3.3 V $\pm 0.165$ V	5.0 V $\pm 0.25$ V	-5.2 V $\pm 0.26$ V
Storage temperature range	T_stg	-40 °C to +85 °C			
Operating temperature range	T_use	-40 °C to +85 °C			
Frequency tolerance	F_tol(osc)	$\pm 35 \times 10^{-6}$ Max. / -40 °C to +85 °C			
Current consumption	Icc	25 mA Max.	65 mA Max.		
Frequency control range	Fcont	$\pm 100 \times 10^{-6}$ Min. Vc= 1.65 V $\pm 1.65$ V or Vc= 2.5 V $\pm 2$ V	$\pm 100 \times 10^{-6}$ Min. Vc= 1.65 V $\pm 1.65$ V	$\pm 100 \times 10^{-6}$ Min. Vc= 2.5 V $\pm 2$ V	
Input resistance	Rin	100 k $\Omega$ Min.(DC level)			
Frequency change polarity	—	Positive slope			
Output load condition	—	50 $\Omega$ (0 dBm Min.)	LV-PECL	PECL	ECL
Oscillation start up time	tosc	10 ms Max. *1			
Frequency aging	F_aging	$\pm 5 \times 10^{-6}$ / year Max. (+25 °C, First year)			

\*1 Time at minimum operating voltage to be 0 s.

**External dimensions**

(Unit:mm)



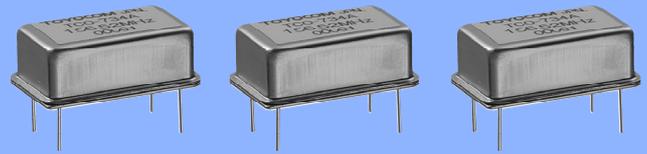
Pin map

#1	Vc
#7	GND/case
#8	Output
#14	Vcc

## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## TCO-7302 Series

- Frequency range : 8 MHz to 52 MHz
- Supply voltage : 3.3 V, 5.0 V
- Frequency control range:  $\pm 100 \times 10^{-6}$
- Features : Wide frequency control range
- : Hermetic double-sealed metal package
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.



Actual size



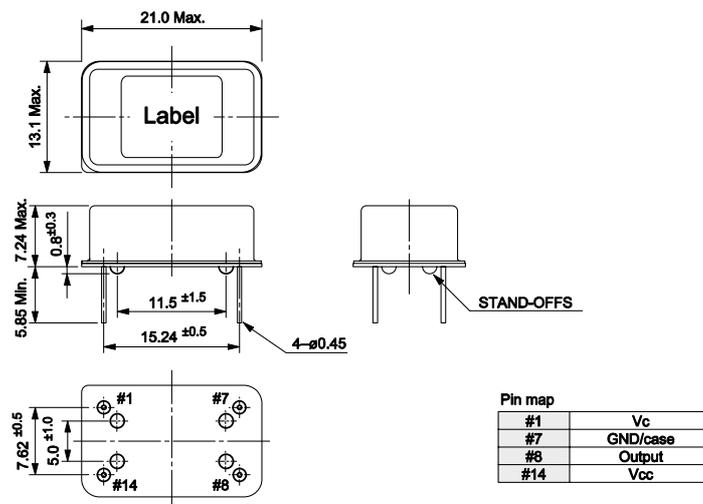
## Specifications (characteristics)

Item	Symbol	TCO-7302A	TCO-7302B	TCO-7302C
Output frequency range	fo	8.000 MHz to 52.000 MHz		
Standard frequency		12.288 MHz, 16.384 MHz, 24.576 MHz, 32.768 MHz, 44.736 MHz, 51.84 MHz		
Supply voltage	Vcc	5.0 V $\pm 0.25$ V		3.3 V $\pm 0.165$ V
Storage temperature range	T_stg	-40 °C to +85 °C		
Operating temperature range	T_use	-20 °C to +70 °C		
Frequency tolerance	F_tol(osc)	$\pm 35 \times 10^{-6}$ Max. / -20 °C to +70 °C		
Current consumption	Icc	30 mA Max.		
Frequency control range	Fcont	$\pm 100 \times 10^{-6}$ Min. Vc= 2.5 V $\pm 2$ V		$\pm 100 \times 10^{-6}$ Min. Vc= 1.65 V $\pm 1.65$ V
Input resistance	Rin	100 k $\Omega$ Min.(DC level)		
Frequency change polarity	—	Positive slope		
Output load condition (CMOS)	L_COMS	—	15 pF Max.	
Output load condition (TTL)	L_TTL	2 TTL Max.	—	—
Oscillation start up time	tosc	10 ms Max. *1		
Frequency aging	F_aging	$\pm 5 \times 10^{-6}$ / year Max. (+25 °C, First year)		

\*1 Time at minimum supply voltage to be 0 s.

## External dimensions

(Unit:mm)







## Temperature Compensated Crystal Oscillator (TCXO)

Category	Model	Actual size (mm) Typ.	Frequency range	Page.
TCXO	TG-3530SA	 10.1×7.4×3.2t	32.768 kHz	92
	TG-5001LA	 3.3×2.6×1.15t	10 MHz to 40 MHz	93
	TG-5010LH	 3.3×2.5×0.96t	10 MHz to 38.4 MHz	94
	TCO-5890 Series	 2.5×2.0×0.9t	10 MHz to 40 MHz	95
	TCO-5860 Series	 3.2×2.5×0.9t	8 MHz to 40 MHz	96
	TCO-5850 Series	 3.2×2.5×0.9t	16 MHz to 30 MHz	97
	TCO-5060/5160 Series	 7.0×5.0×1.9t	10 MHz to 51.84 MHz	98



## Oven Controlled Crystal Oscillator (OCXO)

Category	Model	Size (mm) Typ.	Weight	Frequency range	Page.
OCXO	TCO-6602	32.6×27.2×20.0t (Max.)	40 g	10 MHz to 40 MHz	99
	TCO-6730	51.0×41.0×30.5t (Max.)	150 g	5 MHz, 10 MHz	100
	TCO-676	25.4×25.4×12.7t (Max.)	20 g	10 MHz to 20 MHz	101
	TCO-679	20.3×12.7×9.7t	10 g	10 MHz to 20 MHz	102
	TCO-6920	50.0×50.0×25.0t	100 g	10 MHz	103



## Rubidium Oscillator

Model	Size (mm) Typ.	Weight	Frequency range	Page.
Rb-7000	38.1(H)×165.1(W)×101.6(D)	1.2 kg	10 MHz	104
Rb-2120 GE	99(H)×480(W)×400(D)	12 kg	10 MHz	105



## PLL Module

Model	Size (mm) Typ.	Frequency range	Page.
TCM-2021 Series	19.4×12.9×5.9t SMD type	30MHz to 230 MHz	106

**TCXO**  
**32.768 kHz**

# TG-3530 SA

- Built-in 32.768 kHz crystal oscillator with high accuracy. (adjustment-free efficient operation)
- Temperature compensated circuit : Stabilized frequency tolerance at any operating temperature.
- Oscillation output voltage : 1.5 V to 5.5 V
- Temperature Compensated Voltage : 2.2 V to 5.5 V
- 32.768 kHz output : C-MOS output, output load : 15 pF
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive



Actual size



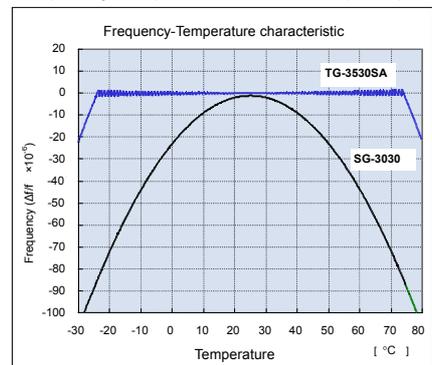
## Specifications (characteristics)

Item	Symbol	Specifications	Condition
Output frequency	$f_o$	32.768 kHz	
Oscillation output voltage	$V_{cc}$	1.5 V to 5.5 V	
Temperature compensated voltage	$V_{cc}$	2.2 V to 5.5 V	
Storage temperature	$T_{stg}$	-55 °C to +125 °C	Stored as bare product after unpacking
Operating temperature	$T_{use}$	-40 °C to +85 °C	
Frequency tolerance	$F_{tol(osc)}$	$\pm 3.8 \times 10^{-6}$ * Equivalent to 10 seconds of monthly deviation	-10 °C to +60 °C $V_{cc} = 3.0 V$
		$\pm 5.0 \times 10^{-6}$ * Equivalent to 13 seconds of monthly deviation	-20 °C to +70 °C $V_{cc} = 3.0 V$
Frequency voltage coefficient	$Fo-V_{cc}$	$\pm 1.0 \times 10^{-6} / V$ Max.	+25 °C $V_{cc} = 2.2 V$ to 5.5 V
Current consumption	$I_{cc}$	6.0 $\mu A$ (Max.)	$V_{cc} = 5.0 V$ , No load condition
		3.0 $\mu A$ (Typ.)	
		4.0 $\mu A$ (Max.) 1.7 $\mu A$ (Typ.)	$V_{cc} = 3.0 V$ , No load condition
Output voltage ("H" level)	$V_{OH}$	$V_{cc} - 0.4 V$ Min.	$I_{OH} = -0.1 mA$ $V_{cc} = 3.0 V$
Output voltage ("L" level)	$V_{OL}$	0.4 V Max.	$I_{OL} = 0.1 mA$ $V_{cc} = 3.0 V$
Output load condition	$L_{CMOS}$	15 pF Max.	CMOS load
Symmetry	SYM	40 % to 60 %	$V_{cc} = 1.5 V$ to 5.5 V 1 / 2 $V_{cc}$ level
Output rise time	$t_r$	200 ns Max.	CMOS load 20 % $V_{cc} \rightarrow 80 \% V_{cc}$
Output fall time	$t_f$	200 ns Max.	CMOS load 80 % $V_{cc} \rightarrow 20 \% V_{cc}$
Oscillation start-up time	$t_{osc}$	1.0 s Max. *1)	+25 °C $V_{cc} = 3.0 V$
		3.0 s Max. *1)	-40 °C to +85 °C $V_{cc} = 3.0 V$
Frequency aging	$F_{aging}$	$\pm 3.0 \times 10^{-6} / year$	+25 °C $V_{cc} = 3.0 V$ , first year

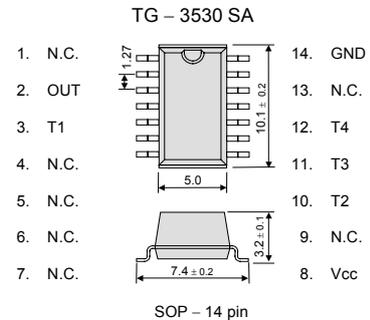
\*1)  $V_{cc}$  rise time < 10ms ( 10 %  $V_{cc}$  - 90 %  $V_{cc}$  )

\*2) If not specifically indicated, -40 °C to +85 °C.

## Frequency temperature coefficient ( Ex. )



## Terminal connection



Signal Name	Input / Output	Function
$V_{cc}$	—	Connected to a positive power supply.
OUT	OUTPUT	32.768 kHz clock output pin (C-MOS).
GND	—	Connected to a ground.
T1, T2 T3, T4	—	* Used by the manufacture for testing. (Do not connect externally.)

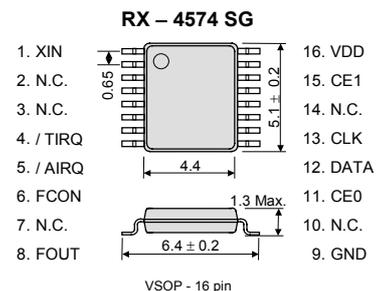
REAL TIME CLOCK IC. For TG-3530SA

# RX-4574 SG

- By combining TG-3530SA with RX-4574SG (real-time clock IC), it is possible to achieve a very high accuracy clock system.
- Functions are compatible with RX-4574 LC and RTC-4574 series (except 32 kHz oscillation function).
- Complies with EU RoHS directive

Note) RX-4574SG does not include the crystal unit.  
The external clock resources (CMOS) of 32.768 kHz are necessary.  
Please input it from the XIN terminal.

## Pin map



## TCXO MINIATURE SIZE LOW PROFILE

# TG-5001LA

- Frequency range : 10 MHz to 40 MHz
- Supply voltage : 2.8 V Typ.
- Applications : GSM,CDMA,WCDMA
- Lead(Pb)-free : Lead free completely



Actual size



### Specifications (characteristics)

Item	Symbol	Specifications		Remarks
		VC-TCXO	TCXO	
Output frequency	$f_0$	10 MHz to 40 MHz 13 MHz, 19.2 MHz, 26 MHz		Standard frequency
Supply voltage	V <sub>CC</sub>	2.8 V ± 0.14 V		
Temperature range	Storage temperature	-40 °C to +85 °C		Stored as bare product after unpacking
	Operating temperature	-30 °C to +85 °C		
Frequency tolerance	F <sub>tol(osc)</sub>	±2.5 × 10 <sup>-6</sup> Max.		After reflow V <sub>C</sub> =1.4 V, +25 °C
Frequency / temperature coefficient	F <sub>o-Tc</sub>	±2.0 × 10 <sup>-6</sup> Max.		-30 °C to +85 °C
Frequency / load coefficient	F <sub>o-Load</sub>	±0.2 × 10 <sup>-6</sup> Max.		10 kΩ // 10 pF ±10 %
Frequency / voltage coefficient	F <sub>o-Vcc</sub>	±0.2 × 10 <sup>-6</sup> Max.		2.8 V ± 0.14 V
Frequency aging	F <sub>aging</sub>	±1.0 × 10 <sup>-6</sup> Max.		+25 °C, First year
Current consumption	I <sub>cc</sub>	1.5 mA Max.		19.2 MHz, V <sub>CC</sub> =2.8 V, 10 kΩ // 10 pF
Input resistance	R <sub>in</sub>	500 kΩ Min.		V <sub>C</sub> - GND (DC), V <sub>C</sub> =1.4 V
Frequency control range	F <sub>cont</sub>	±5.0 × 10 <sup>-6</sup> to ±12.0 × 10 <sup>-6</sup>		V <sub>C</sub> =1.4 V ±1.0 V
Frequency change polarity	—	Positive polarity		—
Symmetry	SYM	40 % to 60 %		GND level (DC cut)
Output level	V <sub>PP</sub>	0.8 V Min.		Peak to peak
Load resistance	Load_R	10 kΩ		
Load capacitance	Load_C	10 pF		DC cut capacitor = 0.01 μF

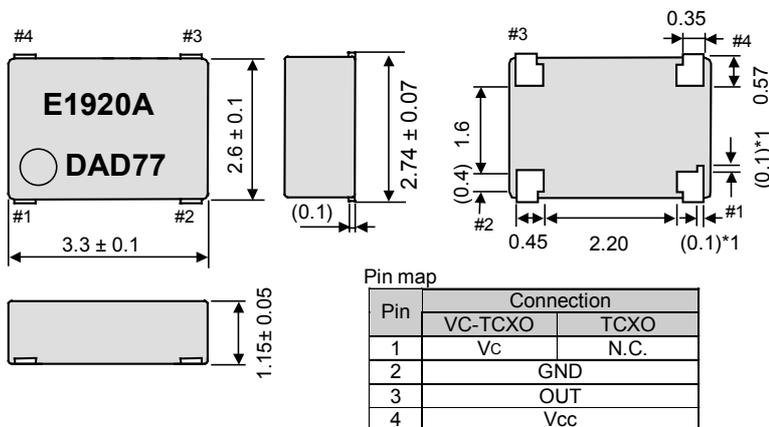
Note: Please contact us for inquiries about specifications other than the above.

### External dimensions

(Unit:mm)

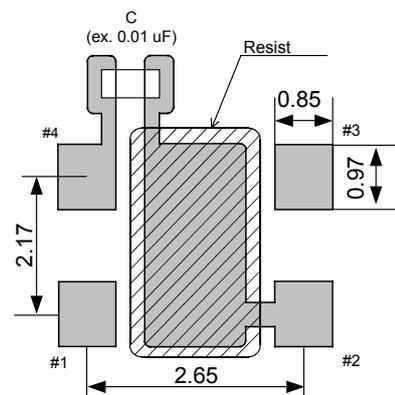
### Footprint (Recommended)

(Unit:mm)



Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

\*1 The terminal of #1 pin may look being the same as #2 to #4 pin.



**TCXO**  
**MINIATURE SIZE LOW PROFILE**

**TG-5010LH**

- Frequency range : 10 MHz to 38.4 MHz
- Supply voltage : 2.8 V Typ.
- Applications : Cellular phone(GSM,CDMA,WCDMA)
- Lead(Pb)-free : Lead free completely



Actual size



**Specifications (characteristics)**

Item	Symbol	Specifications		Remarks
		VC-TCXO	TCXO	
Output frequency	f <sub>0</sub>	10 MHz to 38.4 MHz 13 MHz, 19.2 MHz, 26 MHz		Standard frequency
Supply voltage	V <sub>cc</sub>	2.8 V±0.14 V		
Temperature range	Storage temperature	-40 °C to +85 °C		Stored as bare product after unpacking
	Operating temperature	-30 °C to +85 °C		
Frequency tolerance	F <sub>tol(osc)</sub>	±2.5 × 10 <sup>-6</sup> Max.		After reflow, V <sub>c</sub> =1.4 V, +25 °C
Frequency / temperature coefficient	Fo-Tc	±2.0 × 10 <sup>-6</sup> Max.		-30 °C to +85 °C
Frequency / load coefficient	Fo-Load	±0.2 × 10 <sup>-6</sup> Max.		10 kΩ // 10 pF ±10 %
Frequency / voltage coefficient	Fo-V <sub>cc</sub>	±0.2 × 10 <sup>-6</sup> Max.		2.8 V ± 0.14 V
Frequency aging	F <sub>aging</sub>	±1.0 × 10 <sup>-6</sup> Max.		+25 °C, First year
Current consumption	I <sub>cc</sub>	1.5 mA Max.		19.2 MHz, V <sub>cc</sub> =2.8 V, 10 kΩ// 10 pF
Input resistance	R <sub>in</sub>	500 kΩ Min.	—	V <sub>c</sub> - GND (DC), V <sub>c</sub> =1.4 V
Frequency control range	F <sub>cont</sub>	±5.0 × 10 <sup>-6</sup> to ±12.0 × 10 <sup>-6</sup>		V <sub>c</sub> =1.4 V ±1.0 V
Frequency change polarity	—	Positive polarity		—
Symmetry	SYM	40 % to 60 %		GND level (DC cut)
Output level	V <sub>pp</sub>	0.8 V Min.		Peak to peak
Load resistance	Load_R	10 kΩ		
Load capacitance	Load_C	10 pF		DC cut capacitor = 0.01 μF

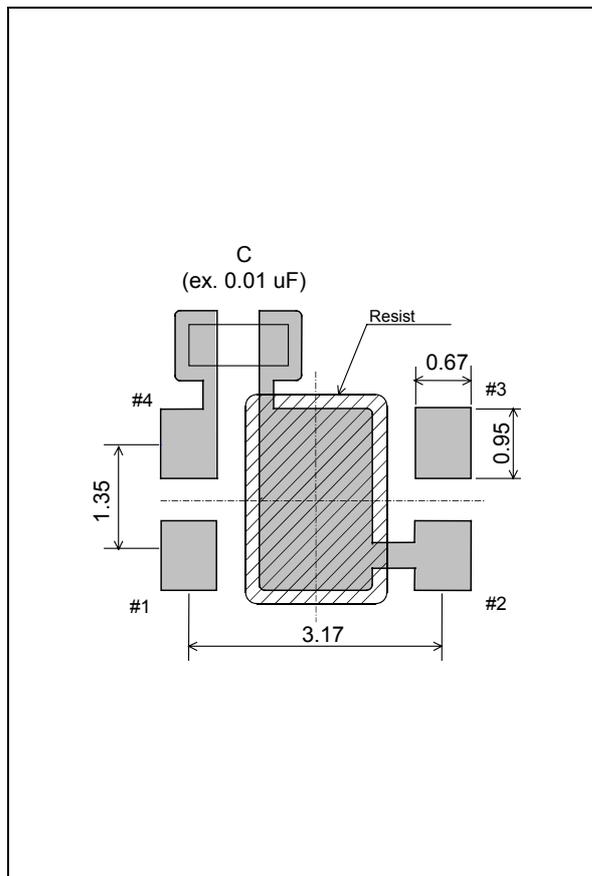
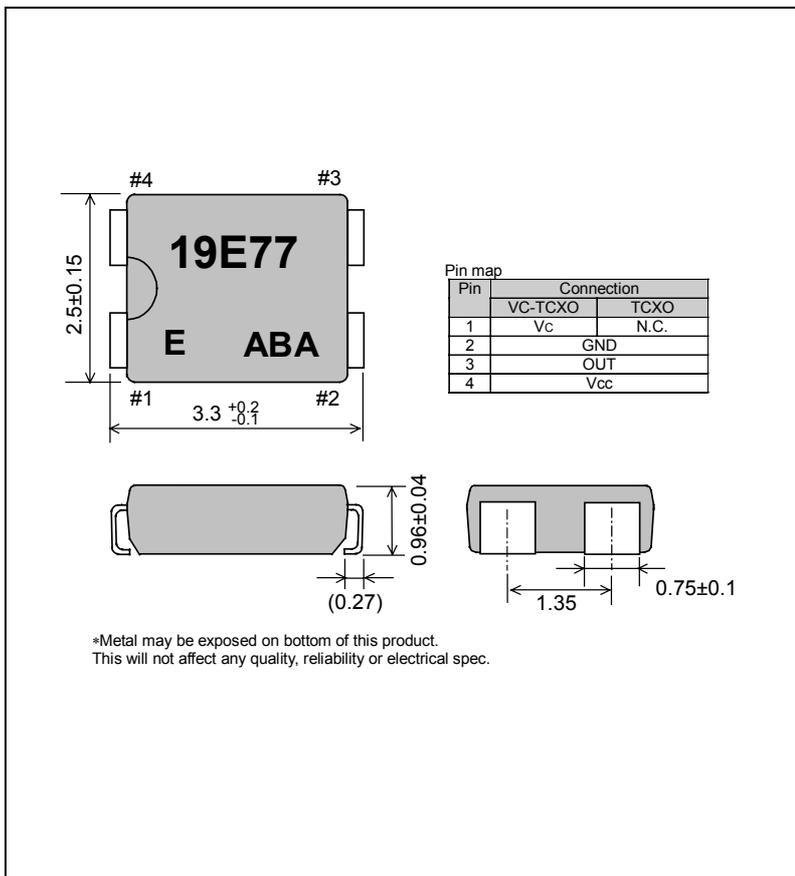
Note:Please contact us for inquiries about specifications other than the above.

**External dimensions**

(Unit:mm)

**Footprint (Recommended)**

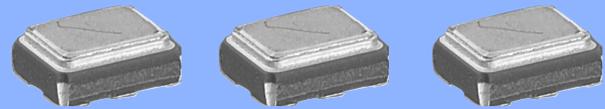
(Unit:mm)



## TCXO ULTRA MINIATURE SIZE LOW PROFILE

### TCO-5890 Series

- Frequency range : 10 MHz to 40 MHz
- Supply voltage : 2.8 V Typ.
- Applications : Cellular phone (CDMA, WCDMA, GSM)
- Features : The minimum size in the industry  
2.5 × 2.0 × 0.9mm
- Low current consumption
- Lead(Pb)-free : Lead free completely



Actual size



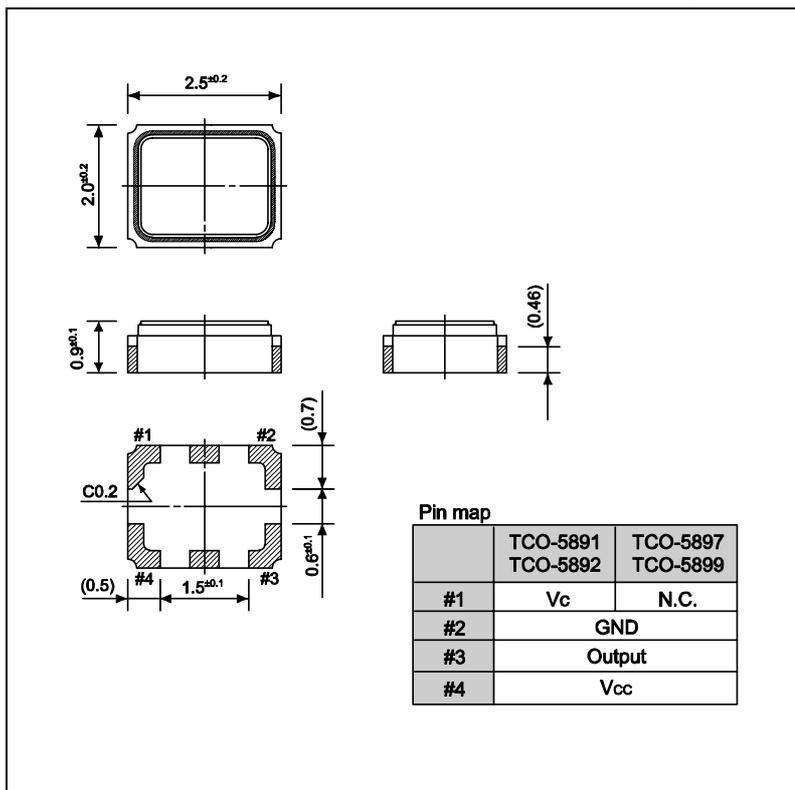
#### Specifications (characteristics)

Item	Symbol	TCO-5891	TCO-5892	TCO-5897	TCO-5899	Remarks
Output frequency range	$f_o$	20 MHz to 40 MHz	10 MHz to 20 MHz		20 MHz to 40 MHz	Standard frequency
		13 MHz, 19.2 MHz, 26 MHz, 38.4 MHz				
Supply voltage	V <sub>cc</sub>	2.8 V ±0.14 V				Supply voltage range : 2.3 V to 3.6 V
Storage temperature range	T <sub>stg</sub>	-40 °C to +85 °C				
Operating temperature range	T <sub>use</sub>	-30 °C to +85 °C				
Frequency tolerance	F <sub>tol</sub>	±2.0 × 10 <sup>-6</sup> Max.				After reflow (V <sub>c</sub> =1.4 V, +25 °C)
Frequency/temperature coefficient	F <sub>0</sub> -T <sub>c</sub>	±2.0 × 10 <sup>-6</sup> Max.				-30 °C to +85 °C
Frequency/load coefficient	F <sub>0</sub> -Load	±0.2 × 10 <sup>-6</sup> Max.				10 kΩ // 10 pF ±10 %
Frequency/voltage coefficient	F <sub>0</sub> -V <sub>cc</sub>	±0.2 × 10 <sup>-6</sup> Max.				V <sub>cc</sub> =2.8 V ±0.14 V
Frequency aging	F <sub>aging</sub>	±1.0 × 10 <sup>-6</sup> Max.				+25 °C, First year
Current consumption	I <sub>cc</sub>	2.0 mA Max.				
Input resistance	R <sub>in</sub>	500 kΩ Min.		—		
Frequency control range	F <sub>cont</sub>	±5.0 × 10 <sup>-6</sup> to ±12.0 × 10 <sup>-6</sup>		—		V <sub>c</sub> =1.4 V ±1.0 V
Frequency change polarity	—	Positive polarity		—		
Symmetry	SYM	40 % to 60 %				GND level (DC cut)
Output level	V <sub>pp</sub>	0.8 V Min.				Peak to peak
Output load condition	Load <sub>R</sub>	10 kΩ				
	Load <sub>C</sub>	10 pF				

\* Note : Please contact us for inquiries about specifications other than the above.

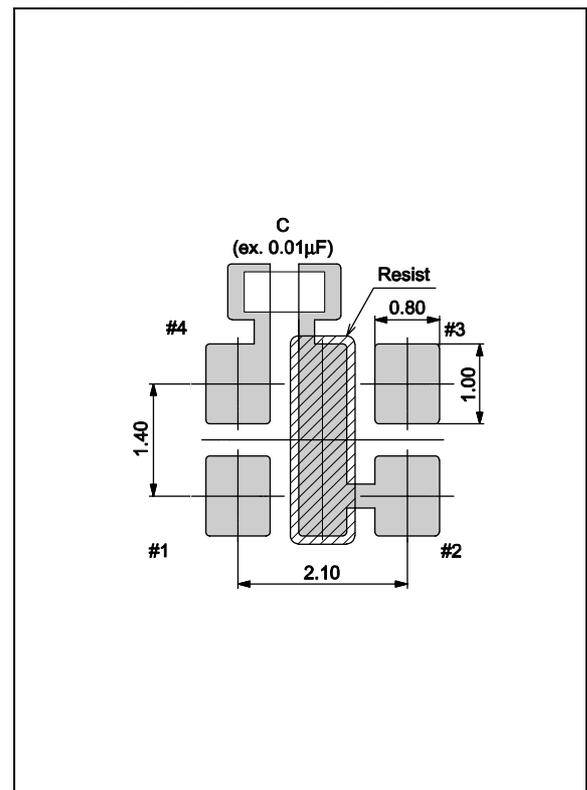
#### External dimensions

(Unit:mm)



#### Footprint (Recommended)

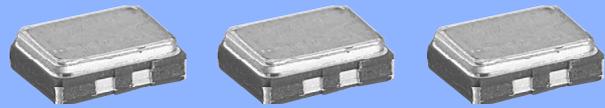
(Unit:mm)



**TCXO**  
**MINIATURE SIZE LOW PROFILE**

**TCO-5860 Series**

- Frequency range : 8 MHz to 40 MHz
- Supply voltage : 2.8 V Typ.
- Applications : Cellular phone (CDMA, WCDMA, GSM)
- Features : Miniature size
- Lead(Pb)-free : Lead free completely



Actual size

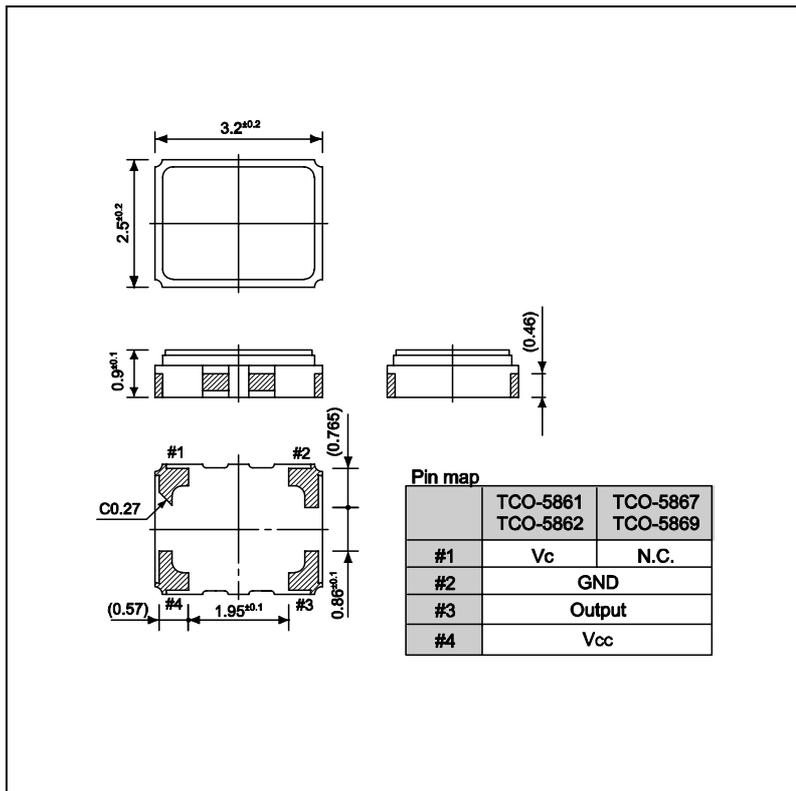
**Specifications (characteristics)**

Item	Symbol	TCO-5861	TCO-5862	TCO-5867	TCO-5869	Remarks
Output frequency range	fo	16 MHz to 40 MHz	8 MHz to 20 MHz		16 MHz to 40 MHz	Standard frequency
		13 MHz, 19.2 MHz, 26 MHz, 38.4 MHz				
Supply voltage	Vcc	2.8 V ±0.14 V				
Storage temperature range	T <sub>stg</sub>	-40 °C to +85 °C				
Operating temperature range	T <sub>use</sub>	-30 °C to +85 °C				
Frequency tolerance	F <sub>tol</sub>	±2.0 × 10 <sup>-6</sup> Max.				After reflow (Vc=1.4 V, +25 °C)
Frequency/temperature coefficient	F <sub>0-Tc</sub>	±2.0 × 10 <sup>-6</sup> Max.				-30 °C to +85 °C
Frequency/load coefficient	F <sub>0-Load</sub>	±0.2 × 10 <sup>-6</sup> Max.				10 kΩ // 10 pF ± 10 %
Frequency/voltage coefficient	F <sub>0-Vcc</sub>	±0.2 × 10 <sup>-6</sup> Max.				Vcc=2.8 V ±0.14 V
Frequency aging	F <sub>aging</sub>	±1.0 × 10 <sup>-6</sup> Max.				+25 °C, First year
Current consumption	Icc	2.0 mA Max.				
Input resistance	Rin	500 kΩ Min.		—		
Frequency control range	Fcont	±5.0 × 10 <sup>-6</sup> to ±12.0 × 10 <sup>-6</sup>		—		Vc=1.4 V ±1.0 V
Frequency change polarity	—	Positive polarity		—		
Symmetry	SYM	40 % to 60 %				GND level (DC cut)
Output level	Vpp	0.8 V Min.				Peak to peak
Output load condition	Load_R	10 kΩ				
	Load_C	10 pF				

\* Note : Please contact us for inquiries about specifications other than the above.

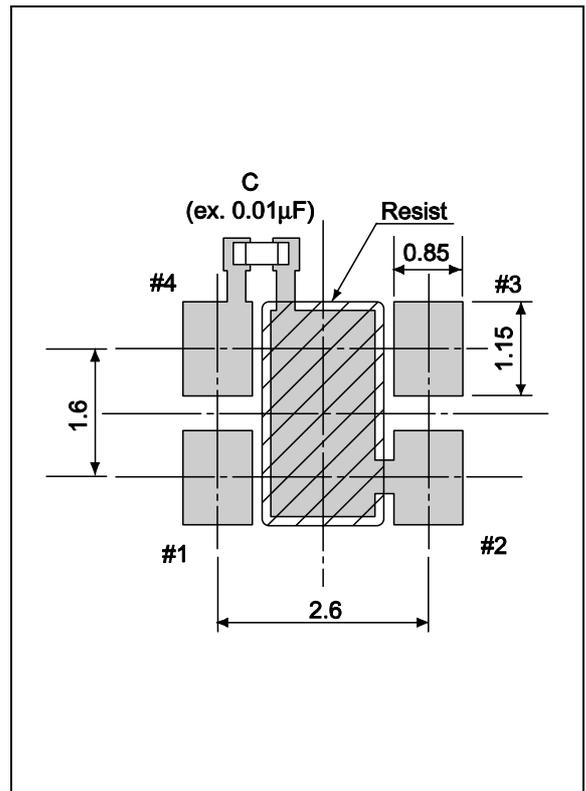
**External dimensions**

(Unit:mm)



**Footprint (Recommended)**

(Unit:mm)



## TCXO MINIATURE SIZE LOW PROFILE, HIGH-STABILITY

### TCO-5850 Series

- Frequency range : 16 MHz to 30 MHz
- Supply voltage : 2.8 V Typ.
- Applications : Cellular phone (GPS)
- Features : Miniature size
- High frequency stability
- Lead(Pb)-free : Lead free completely



Actual size



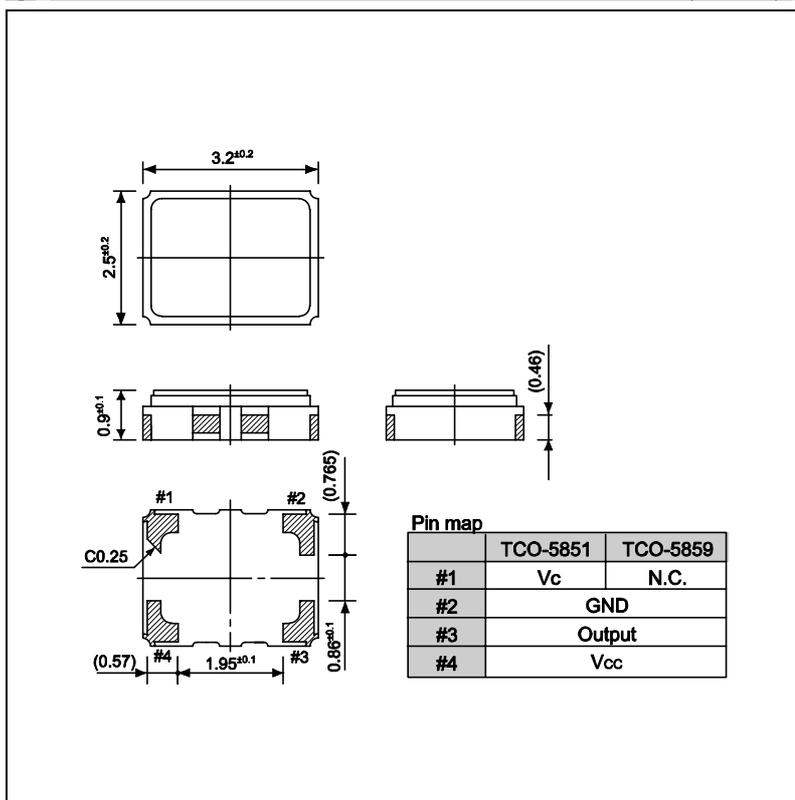
#### Specifications (characteristics)

Item	Symbol	TCO-5851	TCO-5859	Remarks
Output frequency range	f <sub>o</sub>	16 MHz to 30 MHz		Standard frequency Supply voltage range : 2.4 V to 5.5 V
		16.368 MHz, 19.2 MHz, 26 MHz		
Supply voltage	V <sub>CC</sub>	2.8 V ±0.14 V		
Storage temperature range	T <sub>stg</sub>	-40 °C to +85 °C		
Operating temperature range	T <sub>use</sub>	-30 °C to +85 °C		
Frequency tolerance	F <sub>tol</sub>	±2.0 × 10 <sup>-6</sup> Max.		After reflow (V <sub>c</sub> =1.4 V, +25 °C)
Frequency/temperature coefficient	F <sub>0</sub> -T <sub>C</sub>	±0.8 × 10 <sup>-6</sup> Max.		-30 °C to +85 °C
Frequency/load coefficient	F <sub>0</sub> -Load	±0.2 × 10 <sup>-6</sup> Max.		10 kΩ // 10 pF ± 10 %
Frequency/Voltage coefficient	F <sub>0</sub> -V <sub>CC</sub>	±0.2 × 10 <sup>-6</sup> Max.		V <sub>CC</sub> =2.8 V ±0.14 V
Frequency aging	F <sub>age</sub>	±1.0 × 10 <sup>-6</sup> Max.		+25 °C, First year
Current consumption	I <sub>CC</sub>	2.0 mA Max.		
Input resistance	R <sub>in</sub>	500 kΩ Min.	—	
Frequency control range	F <sub>cont</sub>	±5.0 × 10 <sup>-6</sup> to ±12.0 × 10 <sup>-6</sup>	—	V <sub>c</sub> =1.4 V ±1.0 V
Frequency change polarity	—	Positive polarity	—	
Symmetry	SYM	40 % to 60 %		GND level (DC cut)
Output level	V <sub>pp</sub>	0.8 V Min.		Peak to peak
Output load condition	Load <sub>R</sub>	10 kΩ		
	Load <sub>C</sub>	10 pF		

\* Note : Please contact us for inquiries about specifications other than the above.

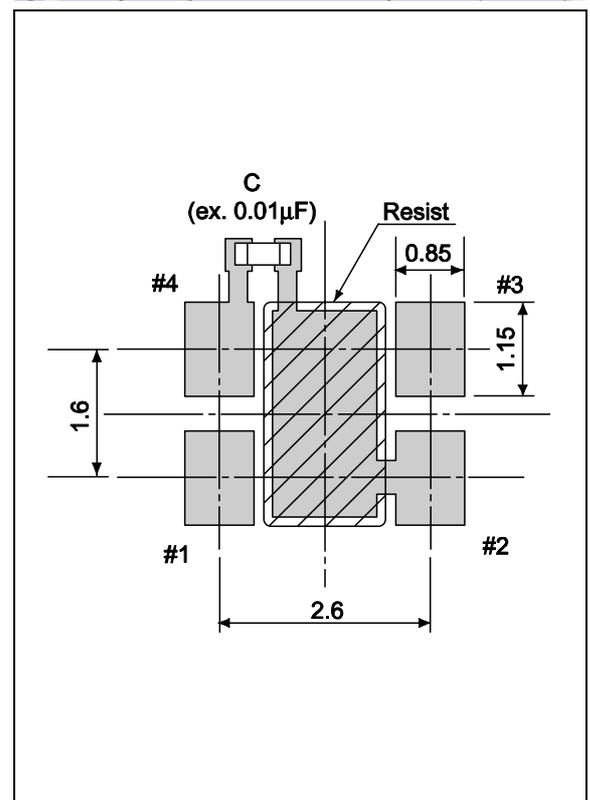
#### External dimensions

(Unit:mm)



#### Footprint (Recommended)

(Unit:mm)



**TCXO  
HIGH-STABILITY**

**TCO-5060 / 5160 Series**

- Frequency range : 10MHz to 51.84 MHz
- Supply voltage : 3.3 V Typ.
- Applications : Basestation, Transmission Measurement Equipment
- Features : High frequency stability
- Function : Output enable(OE)
- Lead(Pb)-free : Lead free completely



Actual size



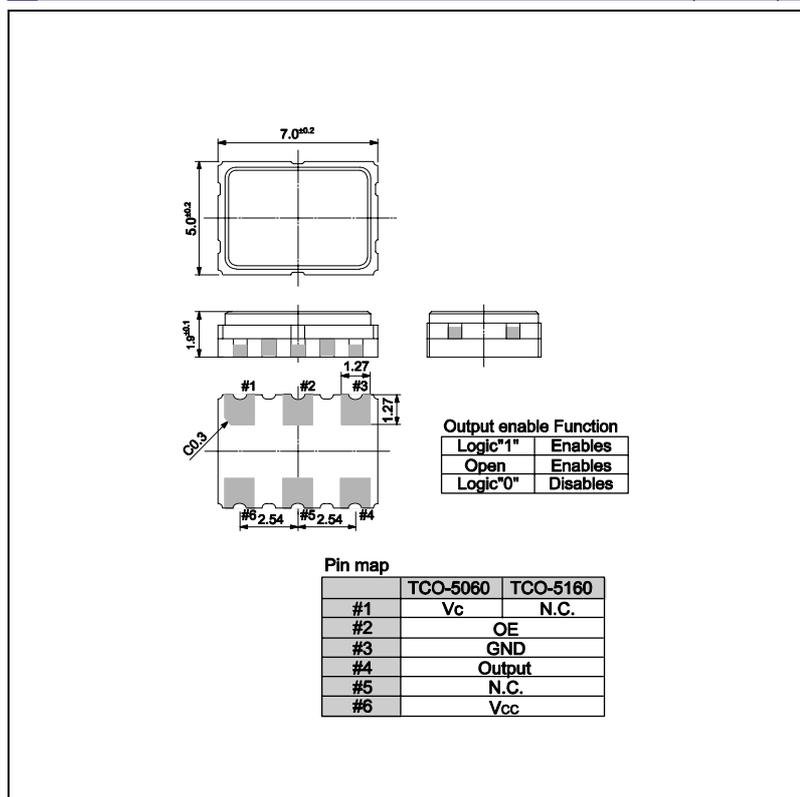
**Specifications (characteristics)**

Item	Symbol	TCO-5060	TCO-5160	Remarks
Output frequency range	f <sub>o</sub>	10.000 MHz to 51.840 MHz 10 MHz, 19.44 MHz, 20 MHz, 24.576 MHz, 38.88 MHz, 40 MHz, 49.152 MHz, 51.84 MHz		Standard frequency
Supply voltage	V <sub>cc</sub>	3.3 V ±0.165 V		Supply voltage range : 2.8 V to 3.6 V
Storage temperature range	T <sub>stg</sub>	-40 °C to +85 °C		
Operating temperature range	T <sub>use</sub>	-40 °C to +85 °C		
Frequency tolerance	F <sub>tol</sub>	±2.0 × 10 <sup>-6</sup> Max.		After reflow (V <sub>c</sub> =1.4 V, +25 °C)
Frequency/temperature coefficient	F <sub>0-Tc</sub>	±1.0 × 10 <sup>-6</sup> Max.		-40 °C to +85 °C
Frequency/voltage coefficient	F <sub>0-Vcc</sub>	±0.5 × 10 <sup>-6</sup> Max.		V <sub>cc</sub> =3.3 V ±0.165 V
Frequency aging	F <sub>aging</sub>	±1.0 × 10 <sup>-6</sup> Max. ±5.0 × 10 <sup>-6</sup> Max.		+25 °C, First year +25 °C, 10 years
Current consumption	I <sub>cc</sub>	10.0 mA Max.		
Input resistance	R <sub>in</sub>	100 kΩ Min.		
Frequency controll range	F cont	±5.0 × 10 <sup>-6</sup> to ±25.0 × 10 <sup>-6</sup>		V <sub>c</sub> =1.65 V ±1.65 V
Frequency change polarity	—	Positive polarity		
Output level	V <sub>pp</sub>	CMOS VOL = 10 % V <sub>cc</sub> Max. VOH = 90 % V <sub>cc</sub> Min.		
Symmetry	SYM	40 % to 60 %		50 % V <sub>cc</sub> level
Output load condition (CMOS)	L_CMOS	15 pF		

\* Note : Please contact us for inquiries about specifications other than the above.

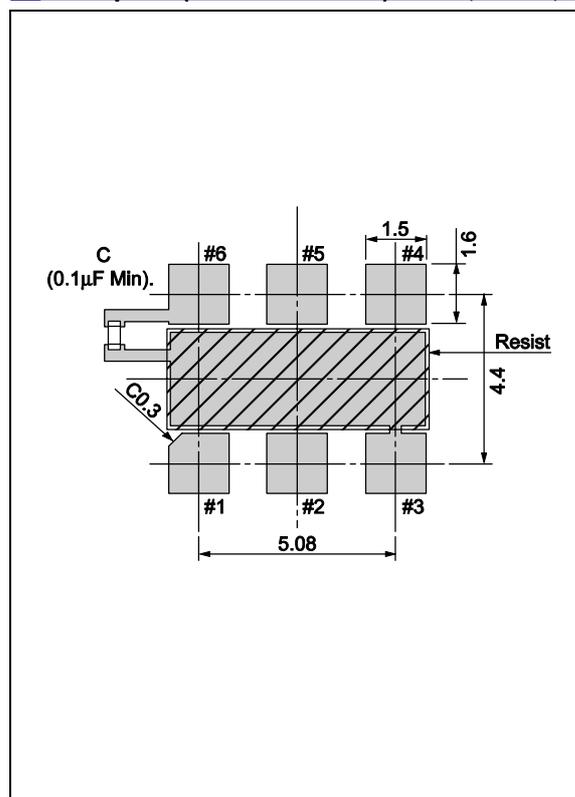
**External dimensions**

(Unit:mm)



**Footprint (Recommended)**

(Unit:mm)



## Oven Controlled Crystal Oscillator (OCXO)

## TCO-6602

- Features : Small size and low power
- : Fast warm-up and high stability
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.

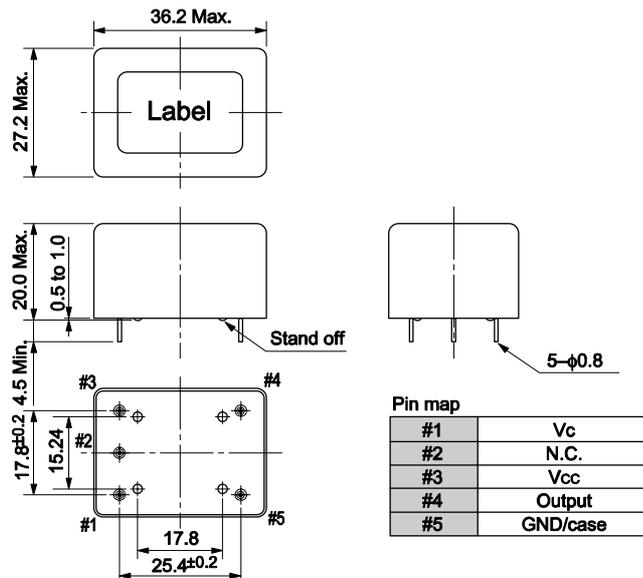


## Specifications (characteristics)

Item	Symbol	Specifications	Remarks
Output frequency range	f <sub>o</sub>	10 MHz to 40 MHz	
		32.768 MHz	Standard frequency
Supply voltage	V <sub>cc</sub>	5.0 V ±0.25 V	
Storage temperature range	T <sub>stg</sub>	-20 °C to +80 °C	
Operating temperature range	T <sub>use</sub>	-10 °C to +70 °C	
Frequency/temperature coefficient	Fo-Tc	±3 × 10 <sup>-8</sup> Max.	-10 °C to +70 °C
Frequency/voltage coefficient	Fo-Vcc	±2 × 10 <sup>-9</sup> Max.	V <sub>cc</sub> =5 V ± 0.25 V
Frequency aging	F <sub>aging</sub>	±1 × 10 <sup>-9</sup> / day Max., ±3 × 10 <sup>-8</sup> / year Max.	
Warm-up	—	±1 × 10 <sup>-7</sup> / 4 min Max.	+25 °C
Output load condition	L <sub>CMOS</sub>	15 pF Max.	
Current consumption	Warm-up	600 mA Max.	
	Steady state at +25 °C	300 mA Max.	
Frequency control range	Fcont	±1 × 10 <sup>-6</sup> Min.	V <sub>c</sub> =2.5 ± 2.5 V
Weight	—	40 g Max.	

## External dimensions

(Unit:mm)



## Oven Controlled Crystal Oscillator (OCXO)

## TCO-6730

- Features : Excellent long and short term stability
- : Low phase noise
- : SC-Cut Crystal unit
- Lead(Pb)-free : Lead free completely

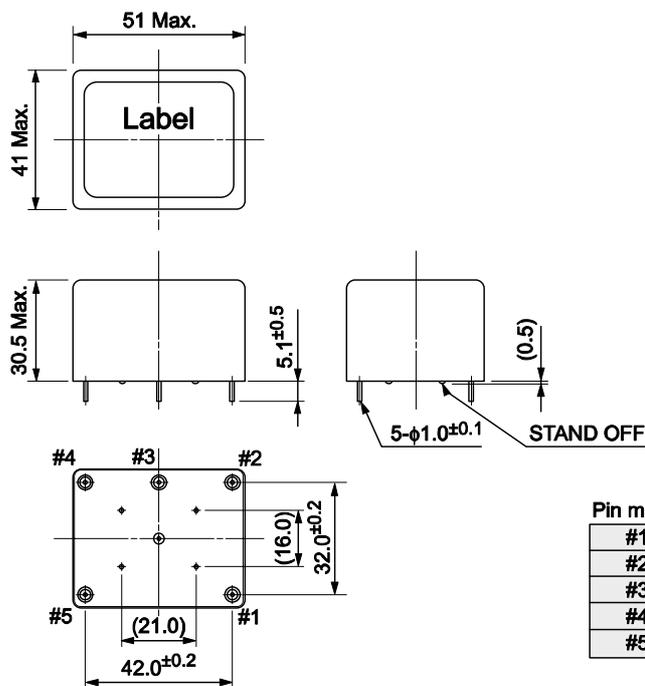


## Specifications (characteristics)

Item	Symbol	Specifications	Remarks
Standard frequency	$f_0$	5 MHz, 10 MHz	
Supply voltage	Vcc	12 V $\pm$ 0.6 V	
Storage temperature range	T_stg	-20 °C to +80 °C	
Operating temperature range	T_use	0 °C to +65 °C	
Frequency/temperature coefficient	Fo-Tc	$\pm 2.5 \times 10^{-9}$ Max.	0 °C to +65 °C
Frequency/voltage coefficient	Fo-Vcc	$\pm 3 \times 10^{-10}$ Max.	Vcc=12 V $\pm$ 0.6 V
Frequency aging	F_aging	$\pm 2 \times 10^{-10}$ / day Max., $\pm 3 \times 10^{-8}$ / year Max.	
Warm-up	—	$\pm 8 \times 10^{-8}$ / 10 min Max.	+25 °C
Output load condition	L_TTL	2 TTL Max.	
Current consumption	Warm-up	600 mA Max.	
	Steady state at +25 °C	220 mA Max.	
Frequency control range	Fcont	$\pm 3 \times 10^{-7}$ Min.	Vc=5V $\pm$ 5V
Weight	—	150 g Max.	

## External dimensions

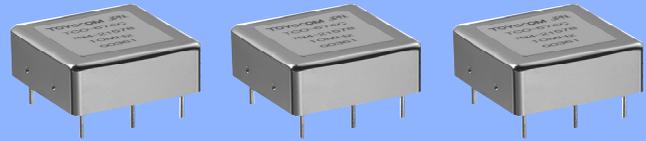
(Unit:mm)



## Oven Controlled Crystal Oscillator (OCXO)

## TCO-676

- Features : Compact and low profile
- : Very fast warm-up
- : SC-Cut Crystal unit
- Lead(Pb)-free : Lead free completely

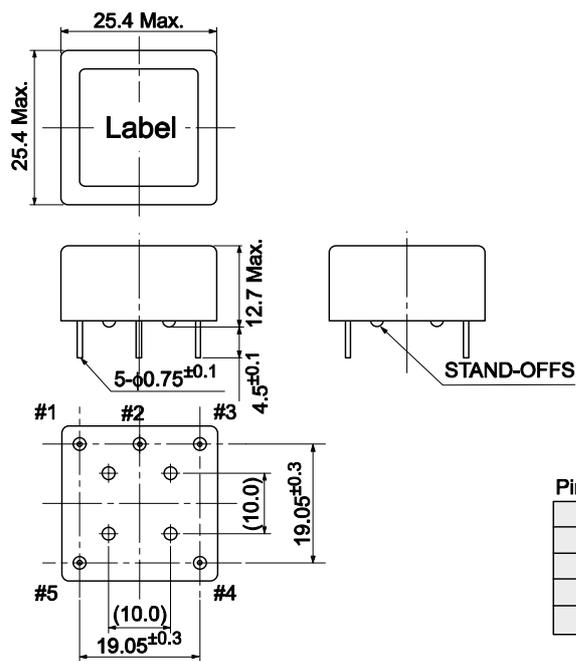


## Specifications (characteristics)

Item	Symbol	Specifications		
Output frequency range	f <sub>o</sub>	10 MHz to 20 MHz		
Standard frequency		10 MHz		
Supply voltage	V <sub>cc</sub>	3.3 V ±0.165 V	5 V ±0.25 V	12 V ±0.6 V
Storage temperature range	T <sub>stg</sub>	-20 °C to +80 °C		
Operating temperature range	T <sub>use</sub>	-10 °C to +70 °C		
Frequency/temperature coefficient	F <sub>o-Tc</sub>	±2 × 10 <sup>-8</sup> Max. / -10 °C to +70 °C		
Frequency/voltage coefficient	F <sub>o-Vcc</sub>	±5 × 10 <sup>-9</sup> Max. V <sub>cc</sub> =3.3 V ±0.165 V	±5 × 10 <sup>-9</sup> Max. V <sub>cc</sub> =5 V ±0.25 V	±5 × 10 <sup>-9</sup> Max. V <sub>cc</sub> =12 V ±0.6 V
Frequency aging	F <sub>aging</sub>	±1 × 10 <sup>-8</sup> / day Max., ±1 × 10 <sup>-7</sup> / year Max.		
Warm-up	—	±5 × 10 <sup>-8</sup> / 5 min Max. (+25 °C)		
Output load condition	Load <sub>R</sub>	10 kΩ		
	Load <sub>C</sub>	15 pF Max.		
Current consumption	Warm-up	1150 mA Max.	700 mA Max.	300 mA Max.
	Steady state at +25 °C	650 mA Max.	300 mA Max.	130 mA Max.
Frequency control range	F <sub>cont</sub>	±1 × 10 <sup>-6</sup> Min. V <sub>c</sub> =1.65 V ±1.65 V	±1 × 10 <sup>-6</sup> Min. V <sub>c</sub> =2.5 V ±2.5 V	
Weight	—	20 g Max.		

## External dimensions

(Unit:mm)



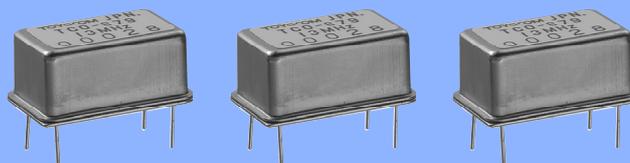
Pin map

Pin	Function
#1	Output
#2	GND/case
#3	V <sub>c</sub>
#4	N.C.
#5	V <sub>cc</sub>

## Oven Controlled Crystal Oscillator (OCXO)

## TCO-679

- Features : DIP-14pin package
- : Very fast warm-up
- : SC-Cut Crystal unit
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.

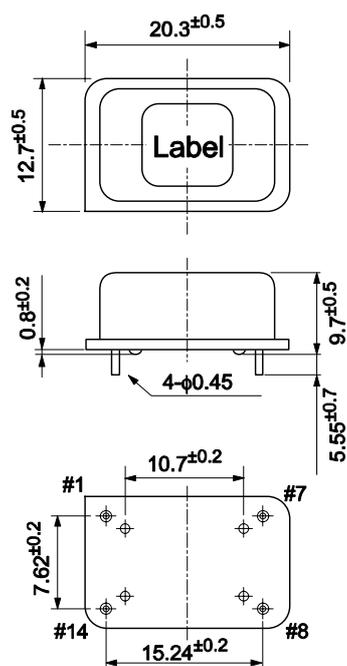


## Specifications (characteristics)

Item	Symbol	Specifications	
Output frequency range	f <sub>o</sub>	10 MHz to 20 MHz	
Standard frequency		10 MHz, 13 MHz	
Supply voltage	V <sub>cc</sub>	5 V ±0.25 V	12 V ±0.6 V
Storage temperature range	T <sub>stg</sub>	-20 °C to +80 °C	
Operating temperature range	T <sub>use</sub>	0 °C to +70 °C	
Frequency/temperature coefficient	Fo-Tc	±1 × 10 <sup>-7</sup> Max. / 0 °C to +70 °C	
Frequency/voltage coefficient	Fo-Vcc	±1 × 10 <sup>-7</sup> Max. / V <sub>cc</sub> =5 V ±0.25 V	±1 × 10 <sup>-7</sup> Max. / V <sub>cc</sub> =12 V ±0.6 V
Frequency aging	F <sub>aging</sub>	±5 × 10 <sup>-8</sup> / day Max., ±5 × 10 <sup>-7</sup> / year Max.	
Warm-up	—	±5 × 10 <sup>-7</sup> / 5 min Max. (+25 °C)	
Output load condition	Load <sub>R</sub>	10 kΩ	
	Load <sub>C</sub>	15 pF Max.	
Current consumption	Warm-up	380 mA Max.	160 mA Max.
	Steady state at +25 °C	160 mA Max.	70 mA Max.
Frequency control range	Fcont	±5 × 10 <sup>-6</sup> Min. / V <sub>c</sub> =2.5 V ±2.5 V	±5 × 10 <sup>-6</sup> Min. / V <sub>c</sub> =4.5 V ±4.5 V
Weight	—	10 g Max.	

## External dimensions

(Unit:mm)



Pin map

#1	V <sub>c</sub>
#7	GND/case
#8	Output
#14	V <sub>cc</sub>

## Oven Controlled Crystal Oscillator (OCXO) DOUBLE OVEN

# TCO-6920

- Features : Ultra-High Stability
- : Low Phase Noise
- : SC-Cut Crystal unit
- : Double Oven
- Lead(Pb)-free : Lead free completely

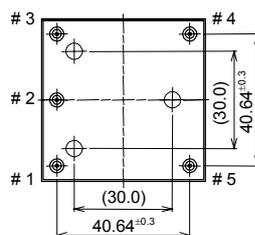
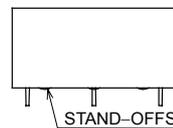
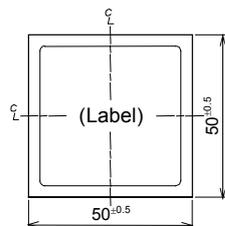


### Specifications (characteristics)

Item	Symbol	Specifications	Remarks
Standard frequency	fo	10 MHz	
Supply voltage	Vcc	12 V ±0.6 V	
Storage temperature range	T_stg	-40 °C to +80 °C	
Operating temperature range	T_use	-30 °C to +70 °C	
Frequency/temperature coefficient	Fo-Tc	±5 × 10 <sup>-10</sup> Max.	-30 °C to +70 °C
Frequency/voltage coefficient	Fo-Vcc	±2 × 10 <sup>-10</sup> Max.	Vcc=12 V ±0.6 V
Frequency aging	F_aging	±5 × 10 <sup>-11</sup> / day Max.	After 30 days of operation
Warm-up	—	±2 × 10 <sup>-8</sup> / 10 min Max.	+25 °C
Output load condition	RL	50 Ω (5 dBm Min.)	Sine wave
Current consumption	Warm-up	1000 mA Max.	
	Steady state at+25 °C	300 mA Max.	
Frequency control range	Fcont	±3 × 10 <sup>-7</sup> Min.	Vc=5 V ±5 V
Weight	—	100 g Max.	

### External dimensions

(Unit:mm)



Pin map

#1	Vc
#2	N.C.
#3	Output
#4	GND
#5	Vcc

## RUBIDIUM ATOMIC OSCILLATOR

# Rb-7000

- Features : Miniature size
- : Low power
- : Low phase noise (Internal OCXO)



### Specifications (characteristics)

Parameter		Standard	Condition
Frequency stability	Long term	$< 5 \times 10^{-11}$ / month	—
	Short term	$< 3 \times 10^{-11}$ / 1 sec	—
	vs Temperature	$< \pm 2 \times 10^{-10}$ / -10 °C to +60 °C	Referred to +25 °C
	Voltage sensitivity	$< \pm 2 \times 10^{-11}$	DC24 V $\pm$ 2 V
	Warm-up (locked frequency)	$< 1 \times 10^{-9}$	within 20 minutes at +25 °C after power on (Typical)
Phase noise : SSB (Typical)		$\leq -90$ dBc / Hz	1 Hz
		$\leq -120$ dBc / Hz	10 Hz
		$\leq -130$ dBc / Hz	100 Hz
		$\leq -140$ dBc / Hz	1 kHz
		$\leq -140$ dBc / Hz	10 kHz
Spurious		$\leq -30$ dB	2 <sup>nd</sup>
		$\leq -40$ dB	3 <sup>rd</sup>
		$\leq -50$ dB	4 <sup>th</sup>
		$\leq -50$ dB	5 <sup>th</sup>
		$\leq -65$ dB	Non-harmonics
Time to lock at short-time off		$\leq 1$ minute	after Warm up
Frequency adjustment		$> 2 \times 10^{-9}$	Internal volume
Output	Frequency	10 MHz	SMA connector
	Level	$> 0.5$ Vrms / 50 $\Omega$	—
	Alarm	Open collector	—
Supply voltage		DC 24 V $\pm$ 2 V	Noise 100mV <sub>pp</sub> Max.
Supply power		$< 15$ W $< 30$ W	+25 °C (steady state) Warm up
Outline (mm)		38.1(H) $\times$ 165.1(W) $\times$ 101.6(D)	—
Weight		$< 1.2$ kg	—

1) Specifications are subject to change without notice.

2) Option : Frequency control  $> 2 \times 10^{-9}$  / 2.5 V  $\pm$ 2.5 V (by external voltage input)

## RUBIDIUM ATOMIC OSCILLATOR (GPS Synchronized Rubidium Frequency Standard)

# Rb-2120GE

- Features : Excellent frequency stability
- : Low phase noise (Internal OCXO)
- Lead(Pb)-free: Lead free completely



### Specifications (characteristics)

Parameter		Standard	Condition
Frequency stability	Long term	$< 5 \times 10^{-11}$ / month	Free-Run Mode
	Short term	$< 3 \times 10^{-11}$ / 1 sec	—
	vs Temperature	$< \pm 2 \times 10^{-10}$ / -10 °C to +45 °C	Free-Run Mode, Referred to +25 °C
	24hours Average	$< \pm 5 \times 10^{-12}$	When synchronized to GPS
Phase noise : SSB (Typical)		$\leq -90$ dBc / Hz	1 Hz
		$\leq -120$ dBc / Hz	10 Hz
		$\leq -130$ dBc / Hz	100 Hz
		$\leq -140$ dBc / Hz	1 kHz
		$\leq -140$ dBc / Hz	10 kHz
Spurious		$< -30$ dB	Harmonics
		$< -60$ dB	Non-harmonics
10M OUT Output	Frequency	10 MHz	Sine wave
	Level	1 Vrms $\pm 30$ % / 50 $\Omega$	8 Outputs + 1 Monitor Output
1PPS OUT Output	Level	TTL Compatible / 50 $\Omega$	8 Outputs + 1 Monitor Output
	Pulse Width	50 $\mu$ sec / Positive Pulse	—
Alarm Output		Rb-OSC Alarm, Output Level Alarm	Alarm Closures, LED Indicators (Red)
GPS Status		LED Indicator	—
		Green : GPS Received Normally Red : GPS Not Received	—
Operating temperature range		-10 °C to +45 °C	—
Supply voltage		DC 48 V $\pm 15$ %	2.0 A Max. Noise 100 mV <sub>pp</sub> Max.
Outline (mm)		99(H) $\times$ 480(W) $\times$ 400(D)	—
Weight		$< 12$ kg	—

1) The specification is subject to change without notice.

PLL Module

# TCM-2021 Series

- Features : Low height, surface mountable type  
: Low SSB phase noise
- Applications : Base station (GSM, W-CDMA)  
: Communication equipment
- Lead(Pb)-free: Contains Pb in this product exempted by RoHS directive.



Actual size

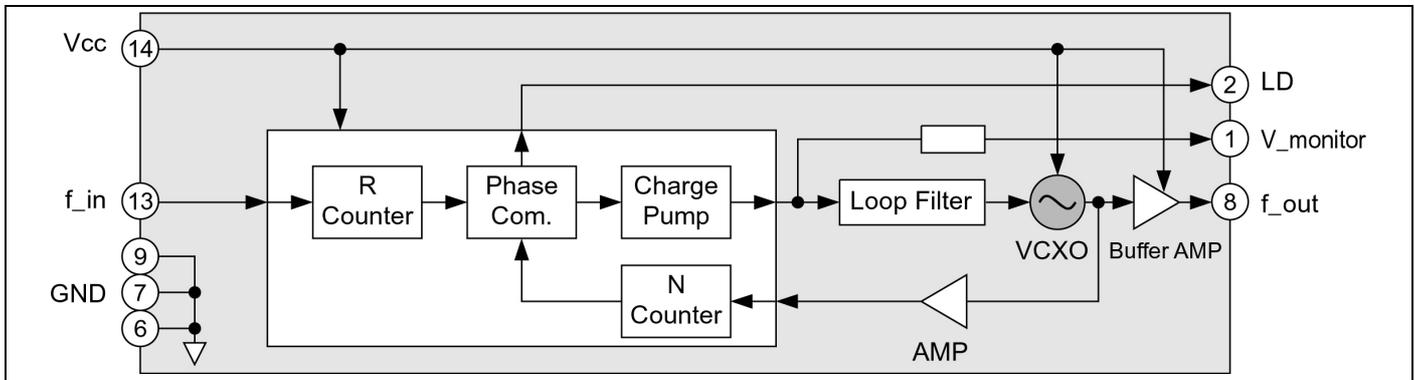


## Specifications (characteristics)

Item	Symbol	Specifications
Output frequency range	—	30 MHz to 230 MHz
Standard output frequency	f <sub>out</sub>	104.00 MHz, 122.88 MHz
Standard input frequency	f <sub>in</sub>	32.768 MHz, 61.44 MHz
Supply voltage	V <sub>cc</sub>	3.3 V ±0.165 V
Current consumption	I <sub>cc</sub>	50 mA Max.
Operating temperature range	T <sub>use</sub>	-10 °C to +75 °C
Input level	—	0.5 V <sub>p-p</sub> Min.
Output level	—	HCMOS
Symmetry	SYM	45 % to 55 %
Phase noise (SSB)	10 Hz	—
	100 Hz	—
	1 kHz	—
	10 kHz	—
	100 kHz	—
		-70 dBc / Hz Max.
		-100 dBc / Hz Max.
		-125 dBc / Hz Max.
		-145 dBc / Hz Max.
		-150 dBc / Hz Max.

note) The above specifications are standard. Please contact us for inquiries about specification.

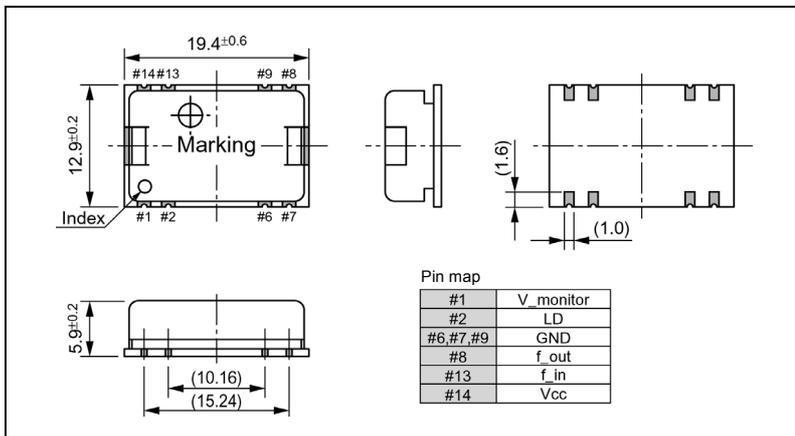
## Block diagram



LD: Lock Detector

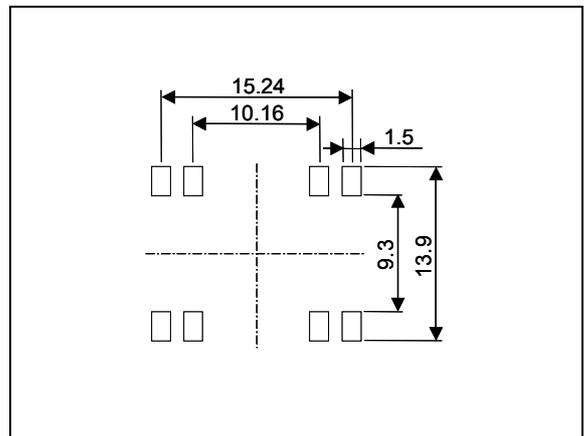
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





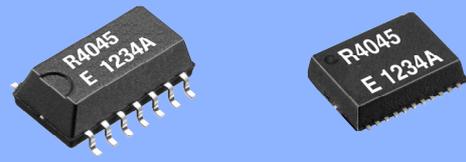
# Real time clock Module

Category	Model	Actual size (mm) Typ.		Features	Page.
Serial 4-Wire	RX-4045SA		10.1×7.4×3.2 t	High-Stability	108
	RX-4045NB		6.3×5.2×1.4 t (Max.)		
	RX-4581NB		6.3×5.2×1.4 t (Max.)	Built-in SRAM	109
	RTC-9701JE		7.3×6.2×1.5 t (Max.)	Built-in EEPROM	110
Serial 3-Wire	RTC-4701JE		7.3×6.2×1.5 t (Max.)	Built-in Temperature Sensor	111
	RTC-4701NB		6.3×5.2×1.4 t (Max.)		
	RTC-4574SA		10.1×7.4×3.2 t	Simple Function	112
	RTC-4574JE		7.3×6.2×1.5 t (Max.)		
	RTC-4574NB		6.3×5.2×1.4 t (Max.)		
	RX-4574LC		3.6×2.8×1.2 t (Max.)		
	RA-4574SA		10.1×7.4×3.2 t	For Automotive	114
	RTC-4543SA		10.1×7.4×3.2 t	Simple Function	115
	RTC-4543SB		11.6×8.0×2.0 t (Max.)		
	I <sup>2</sup> C Bus	RX-8025SA		10.1×7.4×3.2 t	High-Stability
RX-8025NB			6.3×5.2×1.4 t (Max.)		
RTC-8564JE			7.3×6.2×1.5 t (Max.)	Low power consumption	117
RTC-8564NB			6.3×5.2×1.4 t (Max.)		
RX-8564LC			3.6×2.8×1.2 t (Max.)		
RX-8581SA			10.1×7.4×3.2 t	Simple Function	119
RX-8581JE			7.3×6.2×1.5 t (Max.)		
RX-8581NB			6.3×5.2×1.4 t (Max.)		
RA-8581SA		10.1×7.4×3.2 t	For Automotive	120	
Parallel 4-bit	RTC-7301SF		10.5×8.1×2.0 t (Max.)	Built-in Temperature Sensor	121
	RTC-7301DG		DIP 18 pin		
	RTC-62421		DIP 18 pin	4-bit Simple Function	122
	RTC-62423		16.3×12.2×2.8 t (Max.)		
	RTC-72421		DIP 18 pin		
	RTC-72423		16.3×12.2×2.8 t (Max.)		

# High-Stability Frequency SERIAL-INTERFACE REAL TIME CLOCK MODULE

## RX-4045 SA / NB

- Built-in 32.768 kHz quartz oscillator : Frequency adjusted for high accuracy. ( $\pm 5 \times 10^{-6} / T_a = +25^\circ\text{C}$ )
- Interface Type : 4 wire high accuracy serial interface
- Operating voltage range : 1.7 V to 5.5 V
- Wide Timekeeper voltage range : 1.15 V to 5.5 V
- Various detection Functions : Oscillation stop detection function etc.
- Low backup current : 0.48  $\mu\text{A}$  / 3 V (Typ.)
- 32.768 kHz clock frequency output : Open drain output
- Function of time and calendar, the various detection function, and interrupt function etc.
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.



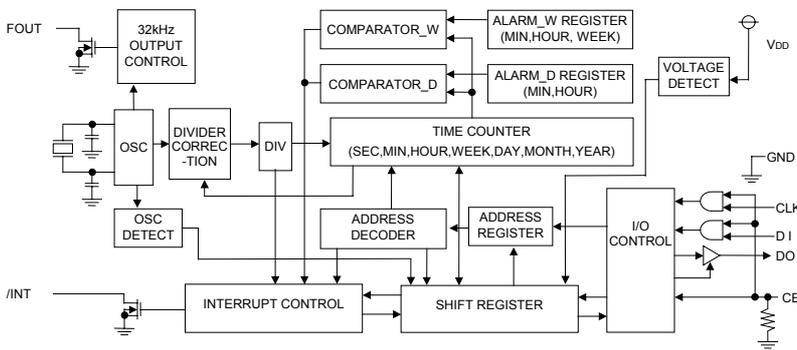
Actual size

RX-4045SA

RX-4045NB



### Block diagram



### Overview

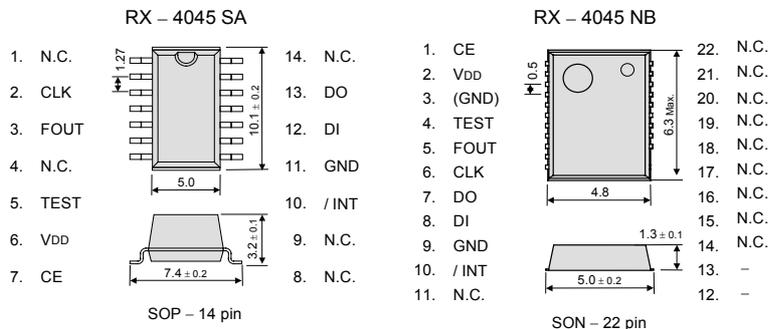
- **Features built-in 32.768 kHz quartz oscillator**
  - Frequency adjusted for high precision ( $\pm 5 \times 10^{-6} / T_a = +25^\circ\text{C}$ ) (Equivalent to 13 seconds of monthly deviation)
- **The various detection Function**
  - Power supply voltage monitoring function (with selectable detection threshold)
  - Stop detection function
  - Power-on reset detection function
- **Equipped with alarm and timer**
  - Timer function produces a periodic interruption signal. As for the Alarm function an optional combination is produced. (Date of the week, time, minute)

### Pin function

Signal Name	Input / Output	Function
CE	Input	The chip enabled input pin. (built-in pull-down resistance) At the "H" level, access becomes possible.
CLK	Input	The shift clock input pin for serial data transfer.
DI	Input	The data input pin for serial data transfer.
DO	Output	The data output pin for serial data transfer.
FOUT	Output	FOUT pin is 32.768 kHz clock output pin that output control is possible. (N-ch open drain) High impedance at the time of output off.
/INT	Output	Interrupt output (N-ch open drain)
TEST	—	* Used by the manufacture for testing. (Do not connect externally.)
VDD	—	Connected to a positive power supply.
GND	—	Connected to a ground.

### Terminal connection / External dimensions

(Unit:mm)



Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

### Specifications (characteristics)

\* Refer to application manual for details.

#### Recommended Operating Conditions

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power voltage	VDD	—	1.7	3.0	5.5	V
Clock voltage	VCLK	—	1.15	3.0	5.5	V
Operating temperature	TOPR	—	-40	+25	+85	°C

#### Frequency characteristics

Item	Symbol	Condition	Rating	Unit
Frequency tolerance	$\Delta f / f$	$T_a = +25^\circ\text{C}$ VDD = 3.0 V	AA: $5 \pm 5^{+1}$ AC: $0 \pm 5^{+2}$	$\times 10^{-6}$
Oscillation start-up time	tSTA	$T_a = +25^\circ\text{C}$ VDD = 2.0 V	1 Max.	s
Frequency / voltage characteristics	f / V	$T_a = +25^\circ\text{C}$ VDD = 2.0 V to 5.5 V	$\pm 1$ Max.	$\times 10^{-6}$

\*1) \*2) Equivalent to 13 seconds of monthly deviation (excluding offset).

#### DC characteristics

$T_a = -40^\circ\text{C}$  to  $+85^\circ\text{C}$

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Current Consumption	I <sub>BK</sub>	CE = GND FOUT ; output OFF (Hi-z)	VDD = 5 V	0.60	1.80	$\mu\text{A}$
			VDD = 3 V	0.48	1.20	
	I <sub>32k</sub>	CE = GND FOUT ; 32.768 kHz output ON	VDD = 3 V	0.65	2.00	$\mu\text{A}$

#### Power supply detection voltage

$T_a = -30^\circ\text{C}$  to  $+70^\circ\text{C}$

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
High-voltage mode	VDETH	VDD pin	1.90	2.10	2.30	V
Low-voltage mode	VDETL	VDD pin	1.15	1.30	1.45	V

**Built-in SRAM  
SERIAL-INTERFACE REAL TIME CLOCK MODULE**

**RX-4581 NB**

- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : Serial interface in 4 lines form.
- Operating voltage range : 1.6 V to 5.5 V
- Wide Timekeeper voltage range : 1.6 V to 5.5 V
- Low backup current : 0.4  $\mu$ A / 3 V ( Typ. )
- Built-in SRAM : Built-in 128 bit ( 8 bit  $\times$  16 ) RAM.
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer.
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.

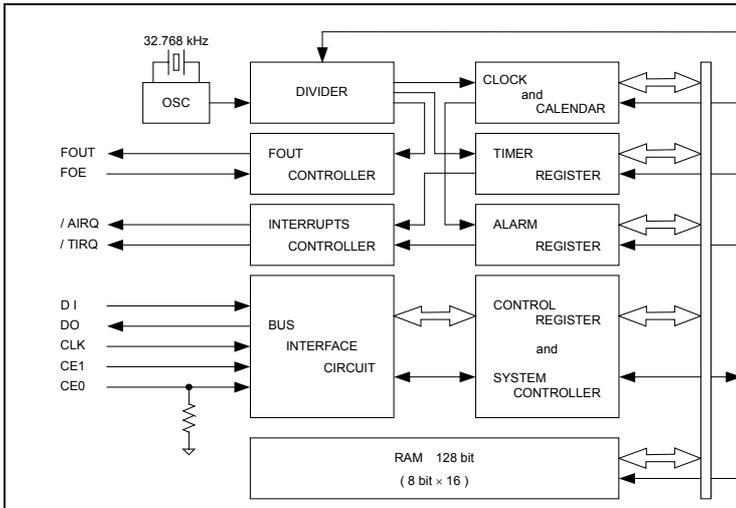


Actual size



**Block diagram**

**Overview**



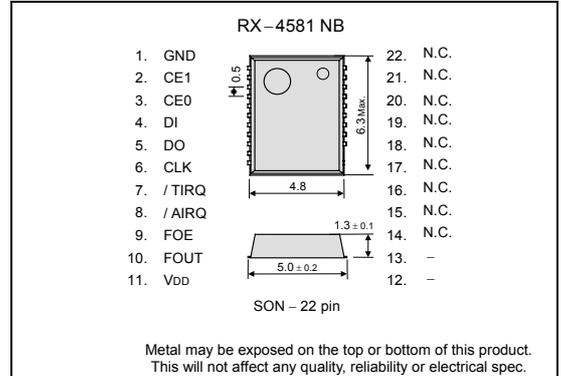
- **Built-in SRAM**
  - Include 128 bit ( 8 bit  $\times$  16 ) RAM.
- **Interface Type**
  - Serial interface in 4 lines form.
  - \* It is possible to make it to 3 lines by wired-OR connecting DI and DO pins.
- **32.768 kHz frequency output function**
  - FOUT pin output (C-MOS output), CL=30 pF
  - FOE pin enables output on/off control.
- **Timer function**
  - Timer function can be set up between 1/4096 second and 4095 minutes.
  - It is recorded automatic to TF-bit at the time of event occurrence, and possible to output with /TIRQ pin output (open-drain output).
- **Interrupt function**
  - Alarm interrupt function , and timer interrupt function.

**Pin Function**

**Terminal connection / External dimensions**

(Unit:mm)

Signal Name	Input/Output	Function
CE0	Input	The chip enabled input pin 0. ( It has a built -in pull-down resistance )
CE1	Input	The chip enabled input pin 1. ( It does not have a built -in pull-down resistance )
CLK	Input	The shift clock input pin for serial data transfer.
DI	Input	The data input pin for serial data transfer.
DO	Output	The data output pin for serial data transfer.
FOUT	Output	This pin outputs the reference clock signal at 32.768 kHz ( CMOS output ). High impedance at the time of output off.
FOE	Input	The input pin for the FOUT output control.
/ AIRQ	Output	The open drain output pin for alarm and time update interrupts.
/ TIRQ	Output	The open drain output pin for timer interrupt.
VDD	—	Connected to a positive power supply.
GND	—	Connected to a ground.



Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

**Specifications (characteristics)**

\* Refer to application manual for details.

**Recommended Operating Conditions**

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power voltage	VDD	—	1.6	3.0	5.5	V
Clock voltage	VCLK	—	1.6	3.0	5.5	V
Operating temperature	TOPR	—	-40	+25	+85	°C

**Frequency characteristics**

Item	Symbol	Condition	Rating	Unit
Frequency tolerance	$\Delta f / f$	Ta = +25 °C VDD = 3.0 V	5 $\pm$ 23 *	$\times 10^{-6}$
Oscillation start-up time	tSTA	Ta = +25 °C VDD = 3.0 V	3 Max.	s

\* Please ask for tighter tolerance. (Equivalent to 1 minute of monthly deviation)

**DC characteristics**

Ta = -40 °C to +85 °C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Current Consumption	I <sub>BK</sub>	CE0, CE1 = GND FOE = GND	VDD = 5 V	0.6	1.2	$\mu$ A
		FOUT ; output OFF (Hi - z)	VDD = 3 V	0.4	0.8	
	I <sub>32k</sub>	CE0, CE1 = GND FOE = VDD	VDD = 5 V	8.0	20.0	$\mu$ A
		FOUT ; 32.768 kHz output ON CL = 30 pF	VDD = 3 V	5.0	12.0	

**Built-in EEPROM  
SERIAL-INTERFACE REAL TIME CLOCK MODULE**

**RTC - 9701 JE**

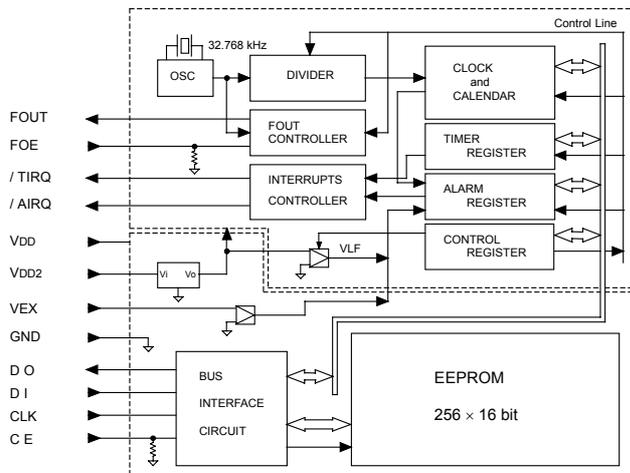
- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : Serial interface in 4 lines form.
- Operating voltage range : 2.7 V to 3.6 V
- Wide Timekeeper voltage range : 1.8 V to 5.5 V
- Include EEPROM : 4 kbit ( 256 × 16 bit )
- Various detection Functions : Ex.Power supply voltage monitoring function
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer.
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.



Actual size



**Block diagram**



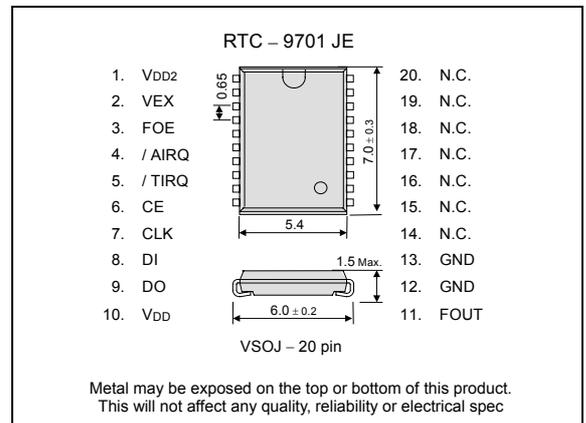
**Overview**

- **Include EEPROM**  
• 4 kbit ( 256 × 16 bit ) User Memory.
- **The various Power supply voltage monitoring function**  
• VEX input pin : Power supply voltage monitoring function  
• VDD2 pin : Low voltage detection function  
• Oscillation circuit : Low voltage detection function
- **Interface Type**  
• Serial interface in 4 lines form.  
• It is possible to make it to 3 lines by wired-OR connecting DI and DO pins.
- **32.768 kHz frequency output function**  
• FOUT pin output (C-MOS output)  
• FOE pin enables output on/off control.
- **The various interrupt function**  
• Alarm interrupt function,  
Time-update interrupt function, timer function.

**Pin Function**

Signal Name	Input / Output	Function
VDD	—	Connected to a positive power supply.
VDD2	—	RTC power. * Always supply the power irrespective of action situation to this terminal.
VEX	—	External voltage detection input pin
CE	Input	The chip enabled input pin. ( built-in pull-down resistance )
CLK	Input	The shift clock input pin for serial data transfer.
DI	Input	The data input pin for serial data transfer.
DO	Output	The data output pin for serial data transfer.
FOUT	Output	This pin outputs the reference clock signal at 32.768 kHz ( CMOS output ). High impedance at the time of output off.
FOE	Input	The input pin for the FOUT output control.
/ AIRQ	Output	Open drain output pin for alarm and time update interrupts.
/ TIRQ	Output	Open drain output pin for timer interrupt.
GND	—	Connected to a ground.

**Terminal connection / External dimensions (Unit:mm)**



**Specifications (characteristics)**

\* If not specifically indicated, VDD = 2.7 V to 3.6 V, VDD2 = 1.8 V to 5.5 V, Ta = -40 °C to +85 °C

\* Refer to application manual for details.

**Recommended Operating Conditions**

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power voltage	VDD	VDD pin	2.7	3.0	3.6	V
Clock voltage	VDD2	VDD2 pin	1.8	3.0	5.5	V
Analog voltage	VEX	VEX pin	1.4		5.5	V
Operating temperature	TOPR	—	-40	+25	+85	°C

**Frequency characteristics**

Item	Symbol	Condition	Rating	Unit
Frequency tolerance	$\Delta f / f$	Ta = +25 °C VDD = 3.0 V	5 ± 23 *	× 10 <sup>-6</sup>

\* Please ask for tighter tolerance. (Equivalent to 1 minute of monthly deviation)

**EEPROM Memory characteristics**

Item	Min.	Typ.	Max.	Unit
Memory contents	4 kbit ( 256 × 16 bit )			—
Program/Erase cycle	10 <sup>5</sup>			times
Current consumption (write to EEPROM)		1	3	mA
Access time		5	10	ms
CLK clock cycle VDD = 3.0 V ± 0.3 V	1000			ns
CLK clock cycle VDD = 3.3 V ± 0.3 V	900			ns

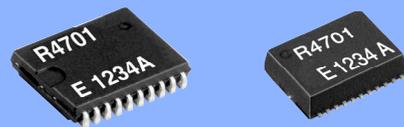
**AC characteristics**

Item	Min.	Typ.	Max.	Unit
CLK clock cycle	500			ns

**Built-in Temperature Sensor  
SERIAL-INTERFACE REAL TIME CLOCK MODULE**

**RTC - 4701 JE / NB**

- Built-in 32.768 kHz quartz oscillator : Frequency adjusted for high accuracy. ( $5 \pm 23 \times 10^{-6}$ )
- Interface Type : Serial interface in 3 lines form.
- Operating voltage range : 1.6 V to 5.5 V
- Wide Timekeeper voltage range : 1.6 V to 5.5 V
- Built-in temperature sensor : Detects temperature. Convert of output to analog voltage
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- Function of time and calendar, the various interrupt function etc.
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.



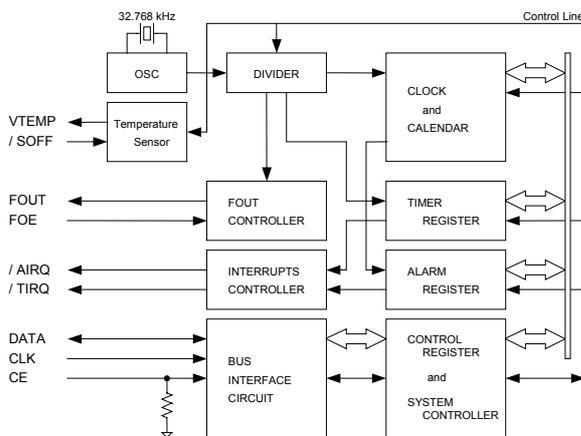
Actual size

RTC-4701JE

RTC-4701NB



**Block diagram**



**Overview**

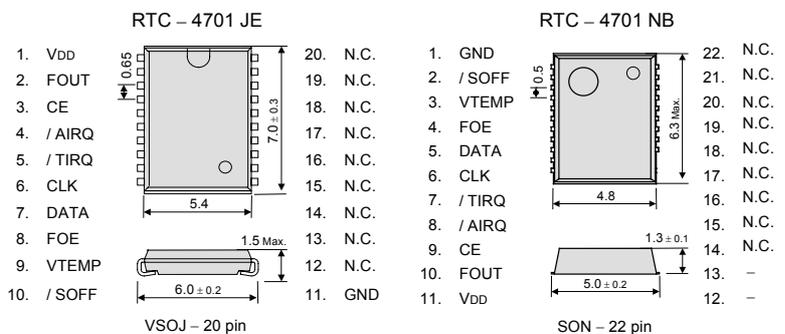
- **Built-in temperature sensor**
  - Diode temperature sensor (analog voltage output)
    - \* temperature sensor operating voltage : 2.7 V to 5.5 V
    - \* temperature sensor tolerance :  $\pm 5^\circ\text{C}$  ( $T_a = +25^\circ\text{C}$ )
    - \* voltage output (analog):  $-7.6 \text{ mV} / ^\circ\text{C}$  Typ.
- **32.768 kHz frequency output function**
  - FOUT pin output (C-MOS output),  $CL=30 \text{ pF}$
  - FOE pin enables output on/off control.
- **The various interrupt function**
  - 12 bit additional counter. ( to 4095 count )
  - Timer function can be set up between 1/4096 second and 255 minutes.
  - Alarm function can be set to day of week, hour, or minute.

**Pin Function**

Signal Name	Input / Output	Function						
CE	Input	The chip enabled input pin. (Built-in pull-down resistance)						
CLK	Input	The shift clock input pin for serial data transfer.						
DATA	Bi-directional	The data input / output pin for serial data transfer.						
FOUT	Output	<table border="1"> <thead> <tr> <th>FOE input</th> <th>FOUT output</th> </tr> </thead> <tbody> <tr> <td>HIGH</td> <td>32.768 kHz output + C-MOS output</td> </tr> <tr> <td>LOW</td> <td>output OFF * Hi - z</td> </tr> </tbody> </table>	FOE input	FOUT output	HIGH	32.768 kHz output + C-MOS output	LOW	output OFF * Hi - z
FOE input	FOUT output							
HIGH	32.768 kHz output + C-MOS output							
LOW	output OFF * Hi - z							
FOE	Input							
VTEMP	Output	The voltage output pin for the temperature sensor ( analog ).						
/SOFF	Input	The input pin for the temperature sensor control.						
/AIRQ	Output	Output 1 pin ( N-ch open drain )						
/TIRQ	Output	Output 2 pin ( N-ch open drain )						
VDD	—	Connected to a positive power supply.						
GND	—	Connected to a ground.						

**Terminal connection / External dimensions**

(Unit:mm)



Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

**Temperature sensor characteristics**

\* Refer to application manual for details.

\* If not specifically indicated, GND = 0 V, VDD = 2.7 V to 5.5 V, Ta = -40 °C to +85 °C

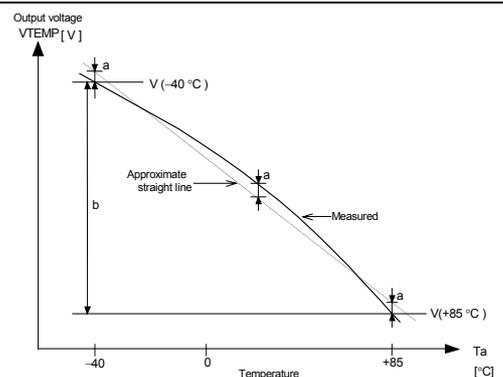
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Temperature output voltage	VTEMP	VTEMP pin, Ta = +25 °C GND based output voltage		1.480		V
Output tolerance	TACR	Ta = +25 °C			$\pm 5.0$	°C
Temperature sensitivity	VSE	-40 °C ≤ Ta ≤ +85 °C	-7.1	-7.6	-8.1	mV / °C
Linearity	ΔNL	-40 °C ≤ Ta ≤ +85 °C			$\pm 2.0$	%
Temperature detection range	TSOP	ΔNL ≤ ± 2.0 %	-40		+ 85	°C
Output resistance	Ro	VTEMP pin, Ta = +25 °C GND standard and VDD standard		1.0	3.0	kΩ

\* Temperature sensitivity  $VSE = (V(+85^\circ\text{C}) - V(-40^\circ\text{C})) / 125 [\text{mV} / ^\circ\text{C}]$

\* Linearity  $\Delta NL = \frac{a}{b} \times 100 [\%]$

\* Output resistance (Ro)  $Ro = \frac{\Delta V}{\Delta I} [\Omega]$

a : Maximum deviation between the measured value of VTEMP and approximate straight line.  
b : Difference between the measured values at -40 °C and +85 °C.



SERIAL-INTERFACE REAL TIME CLOCK MODULE

RTC - 4574 SA / JE / NB

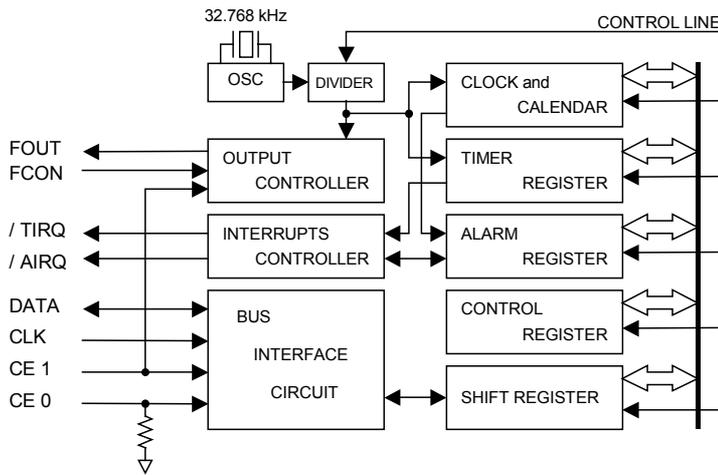
- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : Serial interface in 3 lines form.
- Operating voltage range : 1.6 V to 5.5 V
- Wide Timekeeper voltage range : 1.6 V to 5.5 V
- Low backup current : 0.5  $\mu$ A / 3 V ( Typ. )
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer.
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.



Actual size



Block diagram



Overview

- **32.768 kHz frequency output function**
  - FOUT pin output (C-MOS output ), CL=30 pF
  - Output frequency selectable from 1/30 Hz to 32.768 kHz (32 Values)
- **Timer function**
  - Timer function can be set up between 1/4096 second and 255 minutes.
  - It is recorded automatic to TF-bit at the time of event occurrence, and possible to output with /TIRQ pin output (open-drain output).
  - Selectable one time mode or repeat mode.
- **Alarm function**
  - Alarm function can be set to any combination of day of week, hour, or minute.
  - It is recorded automatic to AF-bit at the time of event occurrence, and possible to output with /AIRQ pin output (open-drain output).
- Functions are compatible with RX - 4574 LC.

Terminal connection / External dimensions

(Unit:mm)

RTC - 4574 SA		RTC - 4574 JE		RTC - 4574 NB	
1. GND	14. FCON	1. VDD	20. N.C.	1. GND	22. N.C.
2. FOUT	13. CE1	2. FOUT	19. N.C.	2. FCON	21. N.C.
3. N.C.	12. DATA	3. CE0	18. N.C.	3. N.C.	20. N.C.
4. N.C.	11. CLK	4. /AIRQ	17. N.C.	4. CE1	19. N.C.
5. N.C.	10. /TIRQ	5. /TIRQ	16. N.C.	5. DATA	18. N.C.
6. N.C.	9. /AIRQ	6. CLK	15. N.C.	6. CLK	17. N.C.
7. VDD	8. CE0	7. DATA	14. N.C.	7. /TIRQ	16. N.C.
		8. CE1	13. N.C.	8. /AIRQ	15. N.C.
		9. FCON	12. N.C.	9. CE0	14. N.C.
		10. GND	11. N.C.	10. FOUT	13. -
				11. VDD	12. -

Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

Specifications (characteristics)

\* Refer to application manual for details.

Recommended Operating Conditions

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power voltage	VDD	—	1.6	3.0	5.5	V
Clock voltage	VCLK	—	1.6	3.0	5.5	V
Operating temperature	TOPR	—	-40	+25	+85	°C

Frequency characteristics

Item	Symbol	Condition	Rating	Unit
Frequency tolerance	$\Delta f/f$	Ta = +25 °C VDD = 3.0 V	5 ± 23 *	× 10 <sup>-6</sup>
Oscillation start-up time	tSTA	Ta = +25 °C VDD = 1.6 V	3 Max.	s

\* Please ask for tighter tolerance.(Equivalent to 1 minute of monthly deviation)

DC characteristics

Ta = -40 °C to +85 °C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Current Consumption	I <sub>BK</sub>	CE0, CE1 = GND	VDD = 5 V	1.0	2.0	$\mu$ A
		FOUT ; output OFF (Hi - z)	VDD = 3 V	0.5	1.0	
	I <sub>32k</sub>	CE0 = GND CE1 = VDD	VDD = 5 V	8.0	20.0	$\mu$ A
		FOUT ; 32.768 kHz output ON CL = 30 pF	VDD = 3 V	5.0	12.0	

## Small size, low profile model package SERIAL-INTERFACE REAL TIME CLOCK MODULE

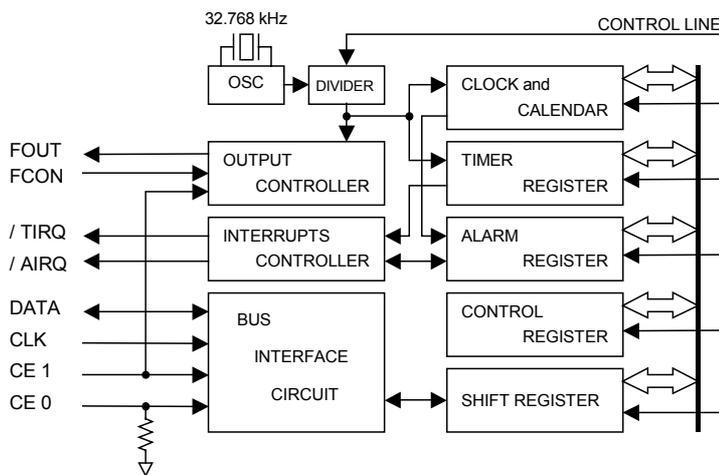
# RX - 4574 LC

- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : Serial interface in 3 lines form.
- Operating voltage range : 1.6 V to 5.5 V
- Wide Timekeeper voltage range : 1.3 V to 5.5 V
- Low backup current : 0.35  $\mu$ A / 3 V (Typ.)
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer.
- Lead(Pb)-free : Contains Pb in sealing glass exempted by RoHS directive.



Actual size

### Block diagram



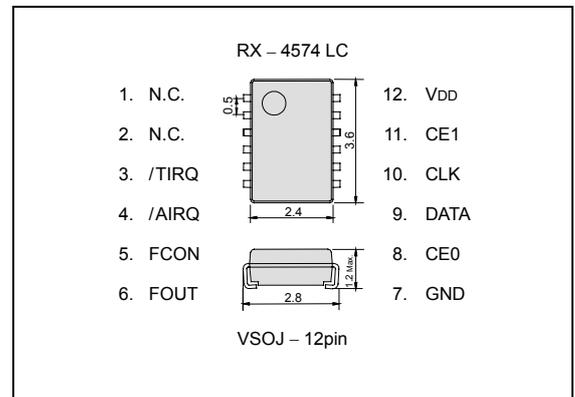
### Overview

- **32.768 kHz frequency output function**
  - FOUT pin output (C-MOS output), CL=30 pF
  - Output frequency is selectable from 1/30 Hz to 32.768 kHz (32 Values)
- **Timer function**
  - Timer function which can be set up between 1/4096 second and 255 minutes.
  - It is recorded automatic to TF-bit at the time of event occurrence, and possible to output with /TIRQ pin output (open-drain output).
  - Selectable one time mode or repeat mode.
- **Alarm function**
  - Alarm function can be set to any combination of day of week, hour, or minute.
  - It is recorded automatic to AF-bit at the time of event occurrence, and possible to output with /AIRQ pin output (open-drain output).
- Functions are compatible with RTC-4574 SA / JE / NB.

### Pin Function

Signal Name	Input / Output	Function
CE0	Input	The chip enabled input pin 0. (Built-in pull-down resistance) When both CE0 and CE1 pins are at the "H" level, access to this Real time clock module becomes possible.
CE1	Input	The chip enabled input pin 1. When the CE1 pin is at the HIGH level, the FOUT pin is in the output state.
CLK	Input	The shift clock input pin for serial data transfer.
DATA	Bi-directional	The data input / output pin for serial data transfer.
FOUT	Output	This pin outputs the reference clock signal at 32.768 kHz (CMOS output). High impedance at the time of output off.
FCON	Input	The input pin for the FOUT output control.
/AIRQ	Output	The open drain output pin for alarm and time update interrupts.
/TIRQ	Output	The open drain output pin for timer interrupt.
VDD	—	Connected to a positive power supply.
GND	—	Connected to a ground.

### Terminal connection / External dimensions (Unit:mm)



### Specifications (characteristics)

\* Refer to application manual for details.

#### Recommended Operating Conditions

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power voltage	VDD	—	1.6	3.0	5.5	V
Clock voltage	VCLK	—	1.3	3.0	5.5	V
Operating temperature	T <sub>OPR</sub>	—	-40	+25	+85	°C

#### Frequency characteristics

Item	Symbol	Condition	Rating	Unit
Frequency tolerance	$\Delta f / f$	T <sub>a</sub> = +25 °C VDD = 3.0 V	5 ± 23 *	× 10 <sup>-6</sup>
Oscillation Start-up time	t <sub>STA</sub>	T <sub>a</sub> = +25 °C VDD = 1.6 V	1 Max.	s
		T <sub>a</sub> = -40 °C to +85 °C VDD = 1.6 V	3 Max.	s

\*Equivalent to 1 minute of monthly deviation

#### DC characteristics

T<sub>a</sub> = -40 °C to +85 °C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Current Consumption	IBK	CE0, CE1 = GND FOUT ; output OFF (Hi - z)	VDD = 5 V	0.45	0.9	$\mu$ A
			VDD = 3 V	0.35	0.7	
Current Consumption	I <sub>32k</sub>	CE0 = GND CE1 = VDD FOUT ; 32.768 kHz output ON CL = 30 pF	VDD = 5 V	8.0	20.0	$\mu$ A
			VDD = 3 V	5.0	12.0	

## For Automotive SERIAL-INTERFACE REAL TIME CLOCK MODULE

# RA - 4574 SA

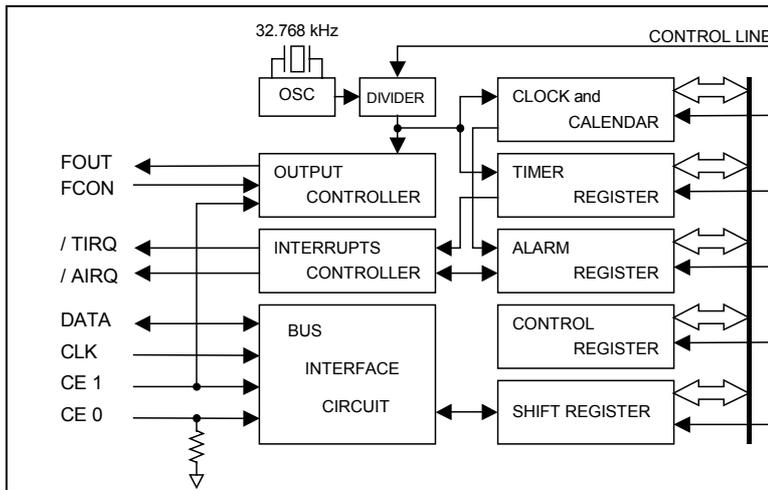
- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : Serial interface in 3 lines form.
- Operating voltage range : 1.6 V to 5.5 V
- Wide Timekeeper voltage range : 1.6 V to 5.5 V
- Low backup current : 0.5  $\mu$ A / 3 V (Typ.)
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer.
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.



Actual size



### Block diagram



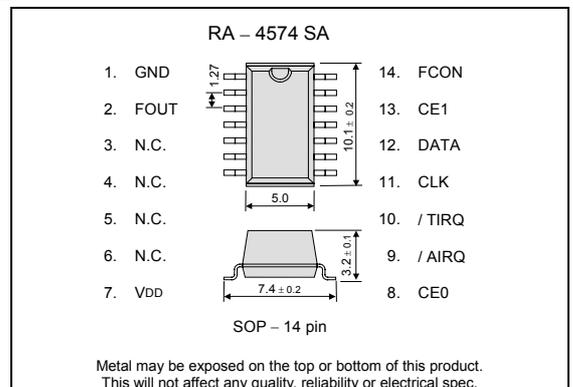
### Overview

- **32.768 kHz frequency output function**
  - FOUT pin output (C-MOS output ), CL=30 pF
  - Output frequency selectable from 1/30 Hz to 32.768 kHz(32 Values)
- **Timer function**
  - Timer function can be set between 1/4096 second and 255 minutes.
  - It is recorded automatic to TF-bit at the time of event occurrence, and possible to output with /TIRQ pin output (open-drain output).
  - Selectable one time mode or repeat mode.
- **Alarm function**
  - Alarm function can be set to any combination of day of week, hour, or minute.
  - It is recorded automatic to AF-bit at the time of event occurrence, and possible to output with /AIRQ pin output (open-drain output).

### Pin Function

Signal Name	Input / Output	Function
CE0	Input	The chip enabled input pin 0. (Built-in pull-down resistance) When both CE0 and CE1 pins are at the "H" level , access to this Real time clock module becomes possible.
CE1	Input	The chip enabled input pin 1. When the CE1 pin is at the HIGH level, the FOUT pin is in the output state.
CLK	Input	The shift clock input pin for serial data transfer.
DATA	Bi-directional	The data input / output pin for serial data transfer.
FOUT	Output	This pin outputs the reference clock signal at 32.768 kHz ( CMOS output ). High impedance at the time of output off.
FCON	Input	The input pin for the FOUT output control.
/ AIRQ	Output	The open drain output pin for alarm and time update interrupts.
/ TIRQ	Output	The open drain output pin for timer interrupt.
VDD	—	Connected to a positive power supply.
GND	—	Connected to a ground.

### Terminal connection / External dimensions (Unit:mm)



### Specifications (characteristics)

\* Refer to application manual for details.

#### Recommended Operating Conditions

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power voltage	VDD	—	1.6	3.0	5.5	V
Clock voltage	VCLK	—	1.6	3.0	5.5	V
Operating temperature	TOPR	—	-40	+25	+85	°C

#### Frequency characteristics

Item	Symbol	Condition	Rating	Unit
Frequency tolerance	$\Delta f / f$	Ta = +25 °C VDD = 3.0 V	5 ± 23 *	$\times 10^{-6}$
Oscillation start-up time	tSTA	Ta = +25 °C VDD = 1.6 V	3 Max.	s

\* Please ask for tighter tolerance.(Equivalent to 1 minute of monthly deviation)

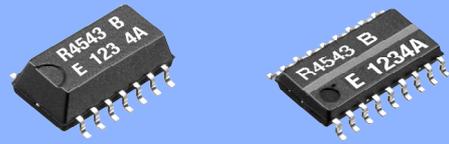
#### DC characteristics

Item	Symbol	Condition	Ta = -40 °C to +85 °C			
			Min.	Typ.	Max.	Unit
Current Consumption	IBK	CE0, CE1 = GND FOUT ; Output OFF ( Hi - z )	VDD = 5 V	1.0	2.0	$\mu$ A
			VDD = 3 V	0.5	1.0	
Current Consumption	I32k	CE0 = GND CE1 = VDD FOUT ; 32.768 kHz output ON CL = 30 pF	VDD = 5 V	8.0	20.0	$\mu$ A
			VDD = 3 V	5.0	12.0	

**Simple Function**  
**SERIAL-INTERFACE REAL TIME CLOCK MODULE**

**RTC - 4543 SA / SB**

- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface type : Serial-interface
- Operating voltage range : 2.5 V to 5.5 V
- Wide Timekeeper voltage range : 1.4 V to 5.5 V
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, timer, and low voltage detection.
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.



Actual size

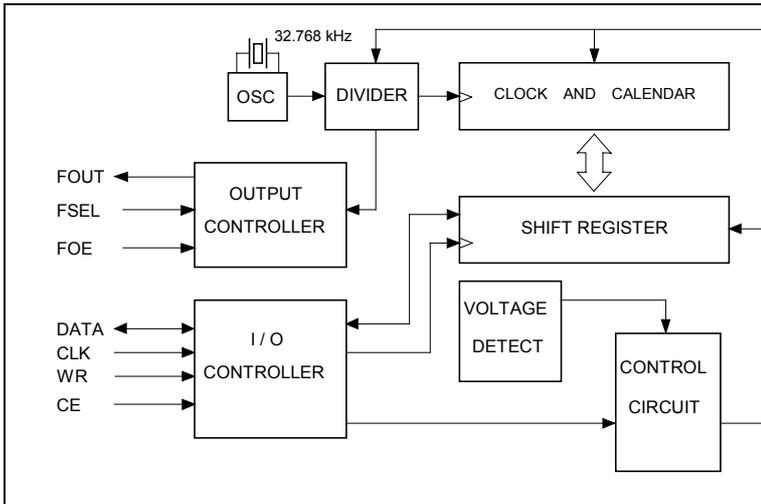
RTC-4543SA



RTC-4543SB



**Block diagram**



**Overview**

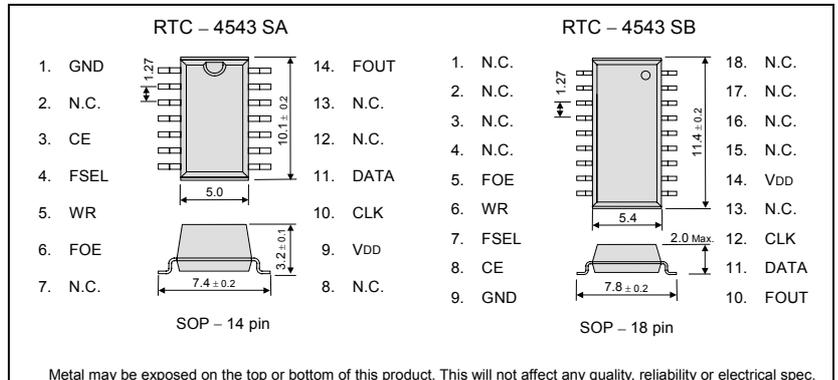
- **32.768 kHz frequency output function**
  - FOUT pin output (C-MOS output ), CL=30 pF
  - FOE pin enables output on/off control.
  - FSEL pin enables output selectable 32.768 kHz or 1Hz.
- **Power supply voltage monitoring function**
  - Detection that power supply voltage descended to 1.7 V or less.
  - Automatic record to FDT-bit at the time of power supply decline detection.

**Pin Function**

Signal Name	Input / Output	Function
CE	Input	The chip enabled input pin. At the HIGH level, access becomes possible.
CLK	Input	The shift clock input pin for serial data transfer.
WR	Input	DATA pin input / output switching pin.
DATA	Bi-directional	The data input / output pin for serial data transfer.
FOUT	Output	32.768 kHz or 1Hz clock output pin (C-MOS output). High impedance at output off.
FOE	Input	The input pin for the FOUT output control.
FSEL	Input	Select the frequency that is output from the FOUT pin.
VDD	—	Connected to a positive power supply.
GND	—	Connected to a ground.

**Terminal connection / External dimensions**

(Unit:mm)



Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

**Specifications (characteristics)**

\* Refer to application Manual for details.

**Recommended Operating Conditions**

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power voltage	VDD	—	2.5	5.0	5.5	V
Clock voltage	VCLK	—	1.4	5.0	5.5	V
Operating temperature	T <sub>OPR</sub>	—	-40	+25	+85	°C

**Frequency characteristics**

Item	Symbol	Condition	Rating	Unit
Frequency tolerance	$\Delta f / f$	T <sub>a</sub> = +25 °C VDD = 5.0 V	5 ± 23 *	× 10 <sup>-6</sup>
Oscillation start-up time	t <sub>STA</sub>	T <sub>a</sub> = +25 °C VDD = 2.5 V	3 Max.	s

\* Please ask for tighter tolerance.(Equivalent to 1 minute of monthly deviation )

**DC characteristics**

T<sub>a</sub> = -40 °C to +85 °C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Current Consumption	I <sub>BK</sub>	CE = GND FOE = GND FOUT ;output OFF (Hi-Z)	VDD = 5 V	1.5	3.0	μA
			VDD = 3 V	1.0	2.0	
			VDD = 2 V	0.5	1.0	

**Supply Voltage Detection Characteristic**

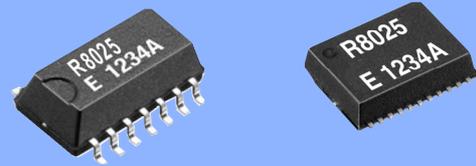
T<sub>a</sub> = -40 °C to +85 °C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power supply detection voltage	V <sub>DT</sub>	VDD pin	1.4	1.7	2.0	V

# High-Stability I<sup>2</sup>C-Bus INTERFACE REAL TIME CLOCK MODULE

## RX - 8025 SA / NB

- Built-in 32.768 kHz quartz oscillator : Frequency adjusted for high accuracy ( $\pm 5 \times 10^{-6}$  / Ta = +25 °C)
  - Interface Type : I<sup>2</sup>C-Bus Interface (400 kHz)
  - Operating voltage range : 1.70 V to 5.5 V
  - Wide Timekeeper voltage range : 1.15 V to 5.5 V
  - Various detection Functions : Ex. Oscillation stop detection function
  - Low backup current : 0.48  $\mu$ A / 3 V (Typ.)
  - 32.768 kHz frequency output function : C-MOS output With Control Pin
  - The various functions include full calendar, alarm, timer.
  - Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.
- \* The I<sup>2</sup>C-Bus is a trademark of Philips Electronics N.V.



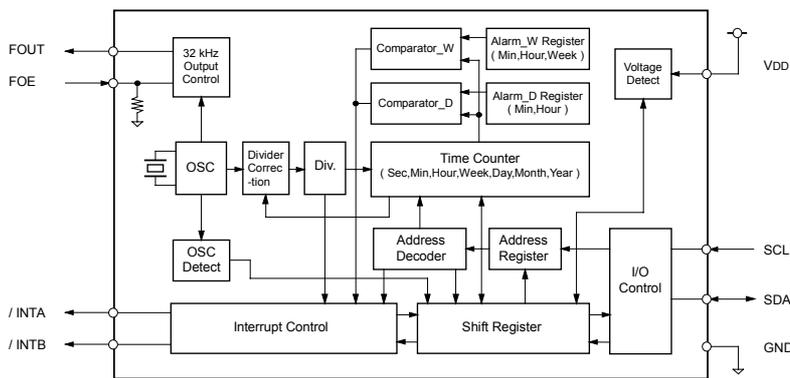
Actual size

RX-8025SA

RX-8025NB



### Block diagram



### Overview

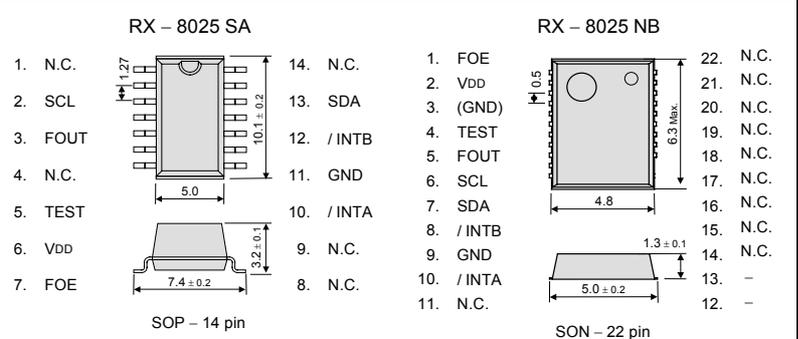
- **Features built-in 32.768 kHz quartz oscillator**
  - Frequency adjusted for high accuracy. ( $\pm 5 \times 10^{-6}$  / Ta = +25 °C) (Equivalent to 13 seconds of monthly deviation)
- **The various detection function**
  - Power supply voltage monitoring function (with selectable detection threshold)
  - Stop detection function
  - Power-on reset detection function
- **Alarm function and Timer function**
  - Timer function produces a periodic interruption signal. As for the Alarm function an optional combination is produced. (Date of the week, time, minute)

### Pin Function

Signal Name	Input / output	Function																								
SCL	Input	Serial clock input pin																								
SDA	Bi-directional	Data input and output pin																								
FOUT	Output	FOUT pin is 32.768 kHz clock output pin (C-MOS) that output control is possible.																								
FOE	Input	<table border="1"> <thead> <tr> <th>FOE input</th> <th>/CLEN1 bit</th> <th>/CLEN2 bit</th> <th>FOUT output</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>X</td> <td>X</td> <td>OFF (LOW)</td> </tr> <tr> <td></td> <td>0</td> <td>0</td> <td>32.768 kHz</td> </tr> <tr> <td></td> <td>0</td> <td>1</td> <td>32.768 kHz</td> </tr> <tr> <td></td> <td>1</td> <td>0</td> <td>32.768 kHz</td> </tr> <tr> <td></td> <td>1</td> <td>1</td> <td>OFF (LOW)</td> </tr> </tbody> </table>	FOE input	/CLEN1 bit	/CLEN2 bit	FOUT output	L	X	X	OFF (LOW)		0	0	32.768 kHz		0	1	32.768 kHz		1	0	32.768 kHz		1	1	OFF (LOW)
FOE input	/CLEN1 bit	/CLEN2 bit	FOUT output																							
L	X	X	OFF (LOW)																							
	0	0	32.768 kHz																							
	0	1	32.768 kHz																							
	1	0	32.768 kHz																							
	1	1	OFF (LOW)																							
/INTA	Output	Interrupt output A pin (N-ch open drain)																								
/INTB	Output	Interrupt output B pin (N-ch open drain)																								
TEST	—	* Used by the manufacture for testing. (Do not connect externally.)																								
VDD	—	Connected to a positive power supply.																								
GND	—	Connected to a ground.																								

### Terminal connection / External dimensions

(Unit:mm)



Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

### Specifications (characteristics)

\* Refer to application manual for details.

#### Recommended Operating Conditions

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power voltage	VDD	—	1.7	3.0	5.5	V
Clock voltage	VCLK	—	1.15	3.0	5.5	V
Operating temperature	TOPR	—	-40	+25	+85	°C

#### Frequency characteristics

Item	Symbol	Condition	Range	Unit
Frequency tolerance	$\Delta f / f$	Ta = +25 °C VDD = 3.0 V	AA: $5 \pm 5$ <sup>*1)</sup> AC: $0 \pm 5$ <sup>*2)</sup>	$\times 10^{-6}$
Oscillation start-up time	t <sub>STA</sub>	Ta = +25 °C VDD = 2.0 V	1 Max.	s
Frequency voltage characteristics	f / V	Ta = +25 °C VDD = 2.0 V to 5.5 V	$\pm 1$ Max.	$\times 10^{-6}$

\*1) \*2) Equivalent to 13 seconds of monthly deviation (excluding offset).

#### DC characteristics

Item	Symbol	Condition	Ta = -40 °C to +85 °C			
			Min.	Typ.	Max.	Unit
Current Consumption	I <sub>BK</sub>	f <sub>SCL</sub> = 0Hz FOE = GND FOUT ; output OFF (LOW)	VDD = 5 V	0.60	1.80	$\mu$ A
		VDD = 3 V	0.48	1.20		
Current Consumption	I <sub>32k</sub>	f <sub>SCL</sub> = 0Hz VDD, FOE = 5.5 V FOUT ; output ON (Output=OPEN; CL = 0 pF)	VDD = 5.5 V	3.0	6.5	$\mu$ A
		VDD = 3 V	—	—		

#### Power supply detection voltage

Item	Symbol	Condition	Ta = -30 °C to +70 °C			
			Min.	Typ.	Max.	Unit
High-voltage mode	VDETH	VDD pin	1.90	2.10	2.30	V
Low-voltage mode	VDETL	VDD pin	1.15	1.30	1.45	V

**Low current consumption**  
**I<sup>2</sup>C-Bus INTERFACE REAL TIME CLOCK MODULE**

**RTC - 8564 JE / NB**

- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : I<sup>2</sup>C-Bus Interface (400 kHz)
- Operating voltage range : 1.8 V to 5.5 V
- Timekeeper voltage range : 1.0 V to 5.5 V / -20 °C to +70 °C
- Low backup current : 275 nA / 3.0 V(Typ.)
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer, and power supply voltage monitoring function
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.

\* The I<sup>2</sup>C-Bus is a trademark of Philips Electronics N.V.



Actual size

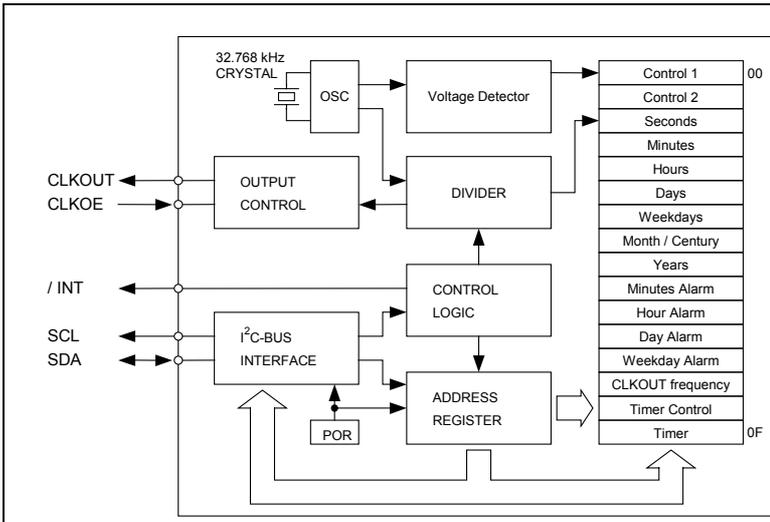
RTC-8564JE

RTC-8564NB



**Block diagram**

**Overview**



**Interface Type**

- I<sup>2</sup>C hi-speed bus specifications. (400 kHz)
- \* I<sup>2</sup>C-Bus slave address : read A3h and write A2h

**Low Timekeeper voltage range**

- 1.0 V to 5.5 V / Ta = -20 °C to +70 °C
- 1.1 V to 5.5 V / Ta = -40 °C to +85 °C

**32.768 kHz frequency output function**

- CLKOUT pin output (C-MOS output), CL=30 pF
- CLKOE pin enables output on/off control.
- Output selectable <32.768 kHz, 1024 Hz, 32 Hz, 1 Hz>

**The various interrupt function**

- Timer function can be set up between 1/4096 second and 255 minutes.
- Alarm function can be set to any combination of day of week, hour, or minute.

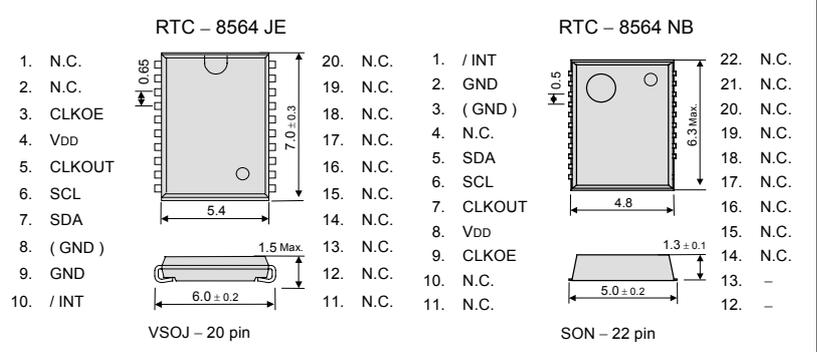
\* Functions are compatible with RX-8564 LC series.

**Pin Function**

**Terminal connection / External dimensions**

(Unit:mm)

Signal Name	Input/Output	Function															
SCL	Input	Serial clock input pin.															
SDA	Bi-directional	Data input and output pin.															
CLKOUT	Output	FOUT pin is 32.768 kHz clock output pin (C-MOS) that output control is possible. CLKOE pin control the frequency output from CLKOUT pin with FE-bit etc.															
CLKOE	Input	<table border="1"> <thead> <tr> <th>CLKOE pin input</th> <th>FE bit</th> <th>CLKOUT pin output</th> </tr> </thead> <tbody> <tr> <td>HIGH</td> <td>1</td> <td>Output (C-MOS)</td> </tr> <tr> <td>0</td> <td>0</td> <td>OFF (LOW)</td> </tr> <tr> <td>LOW</td> <td>1</td> <td>OFF (LOW)</td> </tr> <tr> <td>0</td> <td>0</td> <td>OFF (LOW)</td> </tr> </tbody> </table>	CLKOE pin input	FE bit	CLKOUT pin output	HIGH	1	Output (C-MOS)	0	0	OFF (LOW)	LOW	1	OFF (LOW)	0	0	OFF (LOW)
		CLKOE pin input	FE bit	CLKOUT pin output													
		HIGH	1	Output (C-MOS)													
		0	0	OFF (LOW)													
LOW	1	OFF (LOW)															
0	0	OFF (LOW)															
/INT	Output	Interrupt output (N-ch open drain)															
VDD	—	Connected to a positive power supply.															
GND	—	Connected to a ground.															



Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

**Specifications (characteristics)**

\* Refer to application manual for details.

**Recommended Operating Conditions**

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power voltage	VDD	—	1.8	3.0	5.5	V
Clock voltage	VCLK	—	VLOW	3.0	5.5	V
Operating temperature	TOPR	—	-40	+25	+85	°C

**Low voltage detection**

Item	Symbol	Condition	Typ.	Max.	Unit
Low voltage detection	VLOW	Ta = -20 °C ~ +70 °C	0.9	1.0	V
		Ta = -40 °C ~ +85 °C	0.9	1.1	V

**Frequency characteristics**

Item	Symbol	Condition	Rating	Unit
Frequency tolerance	Δf/f	Ta = +25 °C VDD = 3.0 V	5 ± 23 *	× 10 <sup>-6</sup>

\* Equivalent to 1 minute of monthly deviation

**DC characteristics**

Ta = -40 °C to +85 °C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Current Consumption	IBK	fSCL = 0 Hz CLKOE = GND CLKOUT ; output OFF (LOW)	VDD = 5 V	330	800	nA
			VDD = 3 V	275	700	nA
	I32k	fSCL = 0 Hz CLKOE = VDD CLKOUT ; 32.768 kHz output ON (Output=OPEN ; CL = 0 pF)	VDD = 5 V	2.5	3.4	μA
			VDD = 3 V	1.5	2.2	μA

**Low current consumption /  
Small size, low profile model package  
I<sup>2</sup>C-Bus INTERFACE REAL TIME CLOCK MODULE**

# RX - 8564 LC

- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : I<sup>2</sup>C-Bus Interface (400 kHz)
- Operating voltage range : 1.8 V to 5.5 V
- Wide Timekeeper voltage range : 1.0 V to 5.5 V / Ta = +25 °C
- Low backup current : 275 nA / 3.0 V(Typ.)
- 32.768 kHz frequency output function: C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer, and power supply voltage monitoring function.
- Lead(Pb)-free : Contains Pb in sealing glass exempted by RoHS directive.
- \* The I<sup>2</sup>C-Bus is a trademark of Philips Electronics N.V.

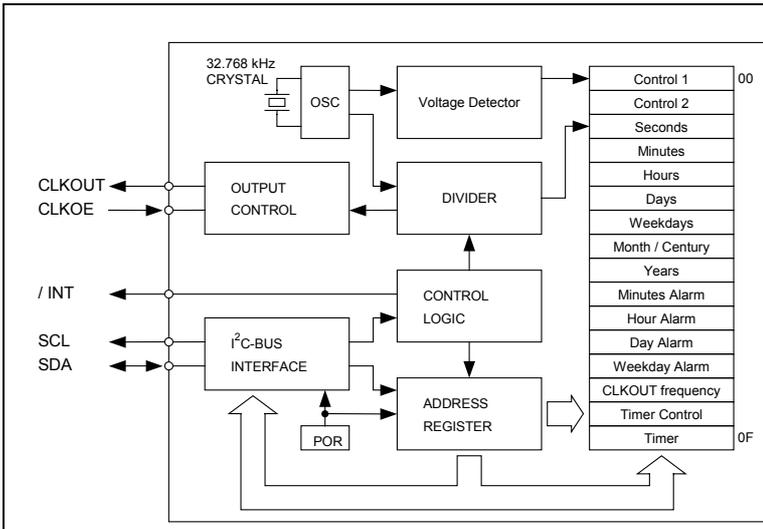


Actual size



## Block diagram

## Overview



### • Interface Type

- I<sup>2</sup>C hi-speed bus specifications. ( 400 kHz )
- \* I<sup>2</sup>C-Bus slave address : read A3h and write A2h

### • Low Timekeeper voltage

- 1.0 V to 5.5 V / Ta = +25 °C
- 1.3 V to 5.5 V / Ta = -40 °C to +85 °C

### • 32.768 kHz frequency output function

- CLKOUT pin output (C-MOS output ), CL=30 pF
- CLKOE pin enables output on/off control.
- Output selectable <32.768 kHz, 1024 Hz, 32 Hz, 1 Hz>

### • The various interrupt function

- Timer function can be set up between 1/4096 second and 255 minutes.
- Alarm function can be set to any combination of day of week, hour, or minute.

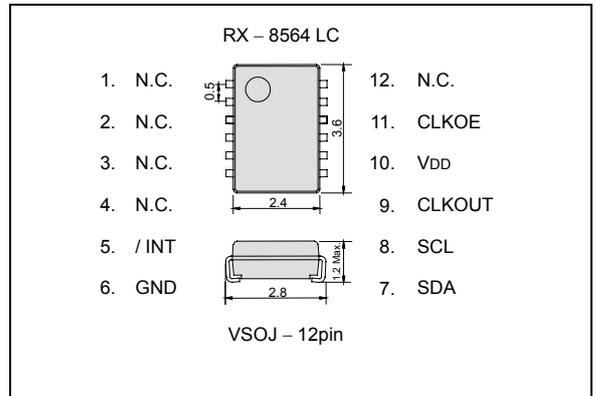
\* Functions are compatible with RTC-8564 JE / NB series.

## Pin Function

## Terminal connection / External dimensions

(Unit:mm)

Signal Name	Input / Output	Function															
SCL	Input	Serial clock input pin															
SDA	Bi-directional	Data input and output pin															
CLKOUT	Output	CLKOUT pin is 32.768 kHz clock output pin (C-MOS) that output control is possible. CLKOE pin control the frequency output from CLKOUT pin with FE-bit, FD1-bit, FDO-bit.															
CLKOE	Input	<table border="1"> <thead> <tr> <th>CLKOE pin input</th> <th>FE bit</th> <th>CLKOUT pin output</th> </tr> </thead> <tbody> <tr> <td>HIGH</td> <td>1</td> <td>Output (C-MOS) ( LOW )</td> </tr> <tr> <td></td> <td>0</td> <td>OFF ( LOW )</td> </tr> <tr> <td>LOW</td> <td>1</td> <td>OFF ( LOW )</td> </tr> <tr> <td></td> <td>0</td> <td>OFF ( LOW )</td> </tr> </tbody> </table>	CLKOE pin input	FE bit	CLKOUT pin output	HIGH	1	Output (C-MOS) ( LOW )		0	OFF ( LOW )	LOW	1	OFF ( LOW )		0	OFF ( LOW )
CLKOE pin input	FE bit	CLKOUT pin output															
HIGH	1	Output (C-MOS) ( LOW )															
	0	OFF ( LOW )															
LOW	1	OFF ( LOW )															
	0	OFF ( LOW )															
/INT	Output	Interrupt output ( N-ch open drain )															
VDD	—	Connected to a positive power supply.															
GND	—	Connected to a ground.															



## Specifications (characteristics)

\* Refer to application manual for details.

### ■ Recommended Operating Conditions

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power voltage	VDD	—	1.8	3.0	5.5	V
Clock voltage	VCLK	—	VLOW	3.0	5.5	V
Operating temperature	TOPR	—	-40	+25	+85	°C

### ■ Low voltage detection

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Low voltage detection	VLOW	Ta = +25°C		0.9	1.0	V
		Ta = -20 °C to +70 °C		0.9	1.2	V
		Ta = -40 °C to +85 °C		0.9	1.3	V

### ■ DC characteristics

Ta = -40 °C to +85 °C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Current Consumption	I <sub>BK</sub>	f <sub>SCL</sub> = 0 Hz CLKOE = GND CLKOUT ; output OFF ( LOW )	VDD = 5 V	330	800	nA
			VDD = 3 V	275	700	
Current Consumption	I <sub>32k</sub>	f <sub>SCL</sub> = 0 Hz CLKOE = VDD CLKOUT ; 32.768 kHz Output ON (Output=OPEN ; CL = 0 pF)	VDD = 5 V	2.5	3.4	µA
			VDD = 3 V	1.5	2.2	

I<sup>2</sup>C-Bus INTERFACE REAL TIME CLOCK MODULE

**RX-8581 SA/ JE/ NB**

- Built-in frequency adjusted 32.768 kHz crystal unit.
  - Interface Type : I<sup>2</sup>C-Bus Interface (400 kHz)
  - Operating voltage range : 1.8 V to 5.5 V
  - Wide Timekeeper voltage range : 1.6 V to 5.5 V
  - Low backup current : 0.45 μA / 3 V (Typ.)
  - 32.768 kHz frequency output function : C-MOS output With Control Pin
  - The various functions include full calendar, alarm, timer.
  - Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.
- \* The I<sup>2</sup>C-Bus is a trademark of Philips Electronics N.V.

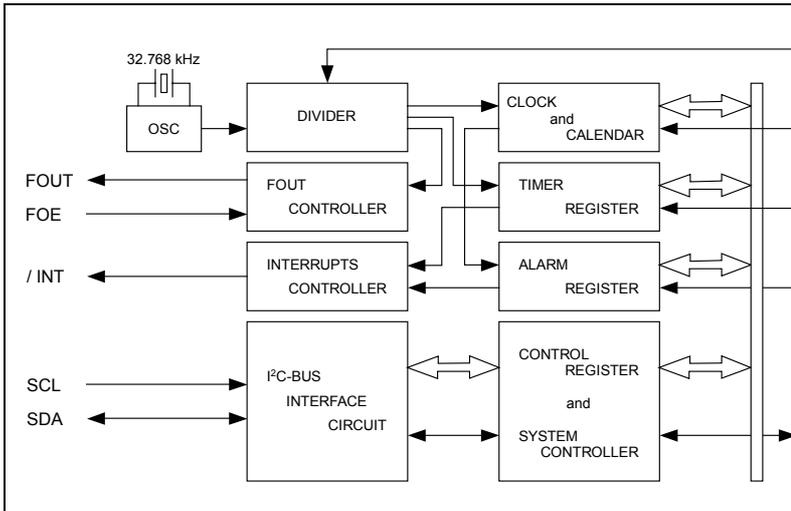


Actual size



**Block diagram**

**Overview**



**Interface Type**

- I<sup>2</sup>C hi-speed bus specifications. (400 kHz)
- \* I<sup>2</sup>C-Bus slave address : read A3h and write A2h

**32.768 kHz frequency output function**

- FOUT pin output (C-MOS output), CL=30 pF
- 32.768 kHz clock frequency output. (Duty 50 ± 5 %)

**Timer function**

- Timer interrupt function can be set up between 1/4096 second and 4095 minutes.
- It is recorded automatic to TF-bit at the time of event occurrence, and possible to output with /TIRQ pin output (open-drain output).

**Interrupt function**

- Alarm interrupt function, Time update interrupt function.

**Terminal connection / External dimensions**

(Unit:mm)

RX - 8581 SA		RX - 8581 JE		RX - 8581 NB	
1. N.C.	14. FOUT	1. N.C.	20. N.C.	1. /INT	22. N.C.
2. SCL	13. N.C.	2. N.C.	19. N.C.	2. GND	21. N.C.
3. SDA	12. N.C.	3. FOE	18. N.C.	3. (V <sub>DD</sub> )	20. N.C.
4. N.C.	11. V <sub>DD</sub>	4. V <sub>DD</sub>	17. N.C.	4. N.C.	19. N.C.
5. GND	10. FOE	5. FOUT	16. N.C.	5. SDA	18. N.C.
6. N.C.	9. N.C.	6. SCL	15. N.C.	6. SCL	17. N.C.
7. /INT	8. N.C.	7. SDA	14. N.C.	7. FOUT	16. N.C.
		8. (V <sub>DD</sub> )	13. N.C.	8. V <sub>DD</sub>	15. N.C.
		9. GND	12. N.C.	9. FOE	14. N.C.
		10. /INT	11. N.C.	10. N.C.	13. -
				11. N.C.	12. -

Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

**Specifications (characteristics)**

\* Refer to application manual for details.

**Recommended Operating Conditions**

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power voltage	V <sub>DD</sub>	—	1.8	3.0	5.5	V
Clock voltage	V <sub>CLK</sub>	—	1.6	3.0	5.5	V
Operating temperature	T <sub>OPR</sub>	—	-40	+25	+85	°C

**Frequency characteristics**

Item	Symbol	Condition	Rating	Unit
Frequency tolerance	Δ f / f	T <sub>a</sub> = +25 °C V <sub>DD</sub> = 3.0 V	5 ± 23 *	× 10 <sup>-6</sup>
FOUT output Duty	tw / t	T <sub>a</sub> = -40 °C to +85 °C V <sub>DD</sub> = 2.4 V to 5.5 V	50 ± 5	%

\* Please ask for tighter tolerance. (Equivalent to 1 minute of monthly deviation)

**DC characteristics**

T<sub>a</sub> = -40 °C to +85 °C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Current Consumption	I <sub>BK</sub>	f <sub>SCL</sub> = 0 Hz FOE = GND	V <sub>DD</sub> = 5 V	0.65	1.2	μA
		FOUT ; output OFF ( LOW )	V <sub>DD</sub> = 3 V	0.45	0.8	
Current Consumption	I <sub>32k</sub>	f <sub>SCL</sub> = 0 Hz FOE = V <sub>DD</sub>	V <sub>DD</sub> = 5 V	8.0	20.0	μA
		FOUT ; 32.768 kHz output ON CL = 30 pF	V <sub>DD</sub> = 3 V	5.0	12.0	

## For Automotive I<sup>2</sup>C-Bus INTERFACE REAL TIME CLOCK MODULE

# RA - 8581 SA

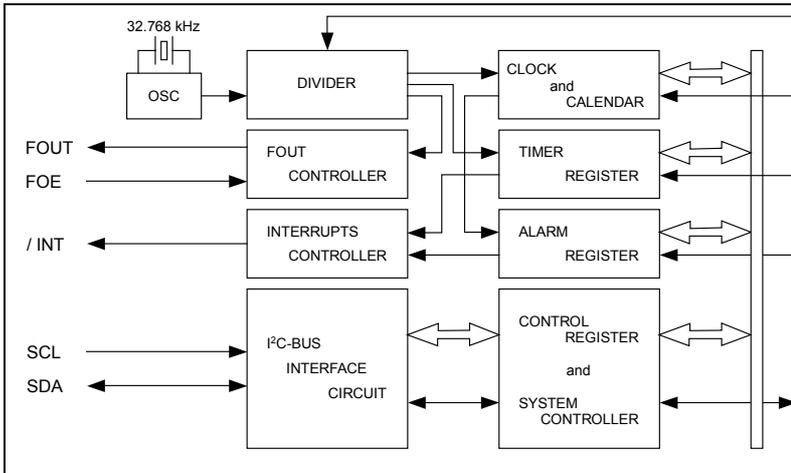
- Built-in frequency adjusted 32.768 kHz crystal unit.
  - Interface Type : I<sup>2</sup>C-Bus Interface (400 kHz)
  - Operating voltage range : 1.8 V to 5.5 V
  - Wide Timekeeper voltage range : 1.6 V to 5.5 V
  - Low backup current : 0.45  $\mu$ A / 3 V (Typ.)
  - 32.768 kHz frequency output function : C-MOS output With Control Pin
  - The various functions include full calendar, alarm, timer.
  - Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.
- \* The I<sup>2</sup>C-Bus is a trademark of Philips Electronics N.V.



Actual size



### Block diagram



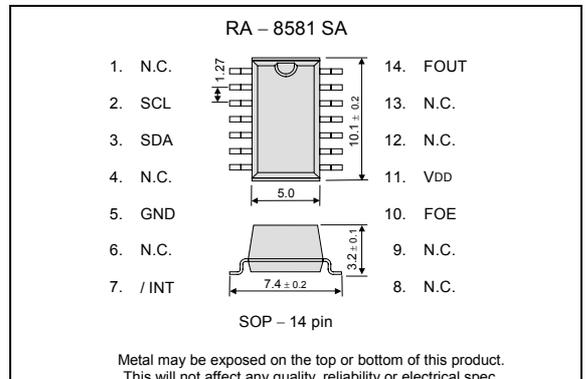
### Overview

- **Interface Type**
  - I<sup>2</sup>C hi-speed bus specifications. (400 kHz)
  - \* I<sup>2</sup>C-Bus slave address : read A3h and write A2h
- **32.768 kHz frequency output function**
  - FOUT pin output (C-MOS output), CL=30 pF
  - 32.768 kHz clock frequency output. (Duty 50  $\pm$ 5%)
- **Timer function**
  - Timer interrupt function can be set up between 1/4096 second and 4095 minutes.
  - It is recorded automatic to TF-bit at the time of event occurrence, and possible to output with /TIRQ pin output (open-drain output).
- **Interrupt function**
  - Alarm interrupt function, Time update interrupt function.

### Pin Function

Signal Name	Input / Output	Function						
SCL	Input	Serial clock input pin						
SDA	Bi-directional	Data input and output pin						
FOUT	Output	FOUT pin outputs the reference clock signal at 32.768 kHz. FOE pin inputs the FOUT output control.						
FOE	Input	<table border="1"> <thead> <tr> <th>FOE pin input</th> <th>FOUT pin output</th> </tr> </thead> <tbody> <tr> <td>HIGH</td> <td>Output (C-MOS)</td> </tr> <tr> <td>LOW</td> <td>OFF (LOW)</td> </tr> </tbody> </table>	FOE pin input	FOUT pin output	HIGH	Output (C-MOS)	LOW	OFF (LOW)
FOE pin input	FOUT pin output							
HIGH	Output (C-MOS)							
LOW	OFF (LOW)							
/INT	Output	Interrupt output (N-ch open drain)						
VDD	—	Connected to a positive power supply.						
GND	—	Connected to a ground.						

### Terminal connection / External dimensions (Unit:mm)



### Specifications (characteristics)

\* Refer to application manual for details.

#### Recommended Operating Conditions

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power voltage	VDD	—	1.8	3.0	5.5	V
Clock voltage	VCLK	—	1.6	3.0	5.5	V
Operating temperature	TOPR	—	-40	+25	+85	°C

#### Frequency characteristics

Item	Symbol	Condition	Rating	Unit
Frequency tolerance	$\Delta f/f$	Ta = +25 °C VDD = 3.0 V	5 $\pm$ 23 *	$\times 10^{-6}$
FOUT output Duty	tw / t	Ta = -40 °C to +85 °C VDD = 2.4 V to 5.5 V	50 $\pm$ 5	%

\* Please ask for tighter tolerance. (Equivalent to 1 minute of monthly deviation)

#### DC characteristics

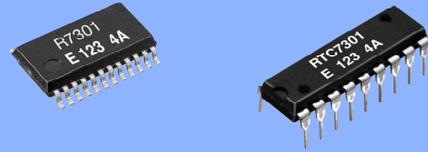
Ta = -40 °C to +85 °C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Current Consumption	IBK	fSCL = 0 Hz FOE = GND FOUT ; Output OFF (LOW)	VDD = 5 V	0.65	1.2	$\mu$ A
			VDD = 3 V	0.45	0.8	
Current Consumption	I32k	fSCL = 0 Hz FOE = VDD FOUT ; 32.768 kHz Output ON CL = 30 pF	VDD = 5 V	8.0	20.0	$\mu$ A
			VDD = 3 V	5.0	12.0	

# 4-bit REAL TIME CLOCK MODULE

## RTC - 7301SF / DG

- Built-in crystal oscillator 32.768 kHz with frequency adjusted
- Frequency selectable clock output (32.768 kHz to 1/30 Hz)
- Built-in 30 second adjustment function, digital pace adjustment function (Max. adjustment:  $\pm 192 \times 10^{-6}$ )
- Built-in alarm and timer interrupt functions.
- Built-in semiconductor temperature sensor (Voltage output: -7.8 mV / °C, RTC-7301SF)
- Operating voltage range: 2.4 V to 5.5 V, time keeping voltage range: 1.6 V to 5.5 V
- Low current consumption (0.6  $\mu$ A / 3 V Typ.)
- High speed parallel interface compatible with SRAM
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.



Actual size

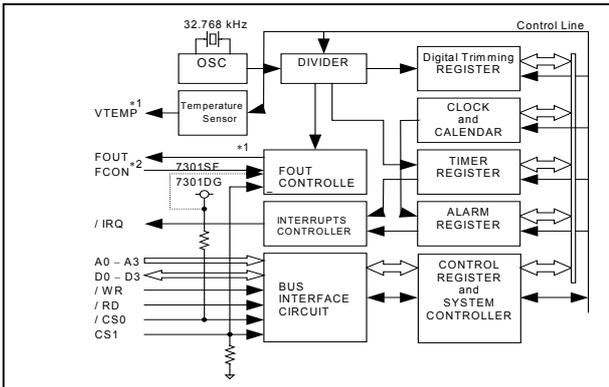
RTC-7301SF



RTC-7301DG



### Block diagram



This is a block diagram for RTC-7301SF.

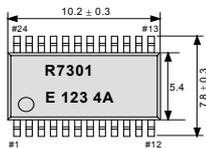
Be aware that RTC-7301DG differs according to the following 2 points.

- \*1) The VTEMP output is not connected to an external pin.
- \*2) The FCON input pin is not connected to an external pin, but is fixed at "H" internally.

### External dimensions/Terminal connection

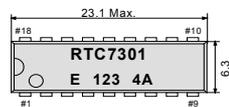
(Unit:mm)

● RTC-7301SF (SSOP 24-pin)

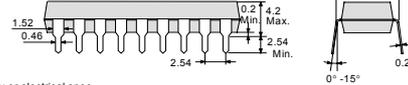


No.	Pin terminal	No.	Pin terminal
1	/CS0	24	VDD
2	FCON	23	(VDD)
3	FOUT	22	(VDD)
4	VTEMP	21	(VDD)
5	(VDD)	20	(VDD)
6	/IRQ	19	(VDD)
7	A0	18	CS1
8	A1	17	D0
9	A2	16	D1
10	A3	15	D2
11	/RD	14	D3
12	GND	13	/WR

● RTC-7301DG (DIP 18-pin)



No.	Pin terminal	No.	Pin terminal
1	/CS0	18	VDD
2	FOUT	17	(VDD)
3	/IRQ	16	(VDD)
4	A0	15	CS1
5	A1	14	D0
6	A2	13	D1
7	A3	12	D2
8	/RD	11	D3
9	GND	10	/WR



Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

### Specifications (characteristics)

\*Refer to application manual for details.

#### ■ Absolute Max. rating

GND=0 V

Item	Symbol	Condition	Min.	Max.	Unit
Supply voltage	VDD	VDD to GND	-0.3	+7.0	
Input voltage	VIN	Input terminal, D0 to D3 pins	GND-0.3	VDD+0.3	V
Output voltage(1)	VOUT1	/IRQ pin		+8.0	
Output voltage(2)	VOUT2	FOUT, D0-D3, VTEMP pin		VDD+0.3	
Storage temperature	TSTG	Stored as bare product after unpacking	-55	+125	°C

#### ■ DC characteristics

(GND=0 V, VDD=1.6 V to 5.5 V, Ta=-40 °C to +85 °C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Current consumption (When non-accessed) FOUT =Output OFF VTEMP=Output OFF	IDD1	/CS0,/RD,/WR=VDD A0-A3,CS1=GND D0-D3,/IRQ=Hi-z	VDD=5 V	—	1.0	2.0
		FOUT=Hi-z(OFF) VTEMP=Hi-z(OFF)				

Note) There is no VTEMP pin on the RTC-7301DG so standards for the VTEMP pin within the conditions described above do not apply.

#### ■ Operating range

GND = 0 V

Item	Symbol	Condition	Min.	Max.	Unit
Power voltage	VDD	—	2.4	5.5	V
Clock voltage	VCLK	—	1.6	—	V
Operating temperature	TOPR	No condensation	-40	+85	°C

#### ■ Frequency characteristics

Item	Symbol	Condition	Range	Unit
Frequency precision	$\Delta f/f$	Ta=+25 °C, VDD=3.0 V	B:5±23 ( <sup>61</sup> )	$\times 10^{-6}$
Oscillation Start up time	tSTA	Ta=+25 °C, VDD=2.4 V	3.0 Max.	s
Frequency temperature characteristics	TOP	Ta=-10 °C to +70 °C VDD=3.0 V, +25 °C	+10 / -120	$\times 10^{-6}$
Frequency voltage characteristics	f/V	Ta=+25 °C, VDD=1.6 V to 5.5 V	±2.0 Max.	$\times 10^{-6}/V$
Aging	fa	Ta=+25 °C, VDD=3.0 V First year	±5.0 Max.	$\times 10^{-6}/year$

(\*1) Please ask tighter tolerance

#### ■ Temperature sensor characteristics

GND=0 V, Ta=-40 °C to +85 °C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Temperature output voltage	VTEMP	Ta=+25 °C, GND based output voltage VTEMP pins, VDD=2.7 V to 5.5 V		1.470		V
Output precision	TACR	Ta=+25 °C, VDD=2.7 V to 5.5 V			±5.0	°C
Temperature sensitivity	VSE	-40 °C ≤ Ta ≤ +85 °C, VDD=2.7 V to 5.5 V	-7.3	-7.8	-8.3	mV/°C
Linearity	ΔNL	-40 °C ≤ Ta ≤ +85 °C, VDD=2.7 V to 5.5 V			±2.0	%
Temperature detection range	TSOP	ΔNL ≤ ±2.0 %, VDD=2.7 V to 5.5 V	-40		+85	°C
Output resistance	Ro	Ta=25 °C, VTEMP pins, VDD=2.7 V to 5.5 V GND standard and VDD standard		1.0	3.0	kΩ
Load condition	CL	VDD=2.7 V to 5.5 V			100	pF
	RL	VDD=2.7 V to 5.5 V		500		kΩ
Response time	trSP	VDD=3.3 V CL=50 pF, RL=500 kΩ, Max. ±1 °C			200	μs

Note) There is no temperature sensor function on the RTC-7301DG.

## 4-bit REAL TIME CLOCK MODULE

# RTC - 62421 / 62423

- Built-in crystal unit allows adjustment-free efficient operation.
- 24 h / 12 h changeable and leap year automatically adjustable (Gregorian calendar).
- Pins and functions are compatible with the MSM6242 series.
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.



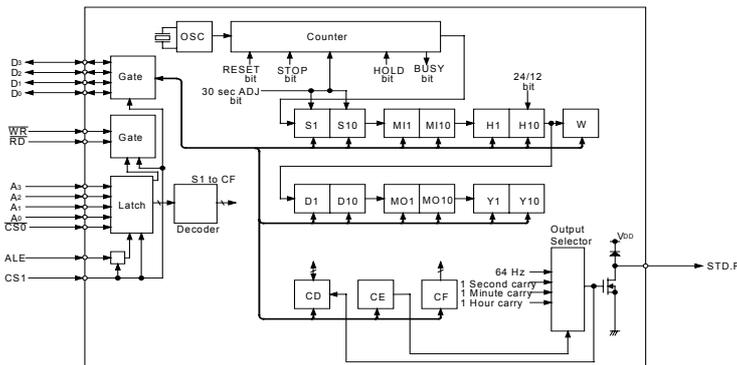
Actual size

RTC-62421

RTC-62423



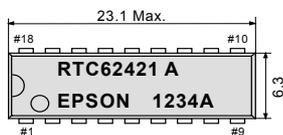
### Block diagram



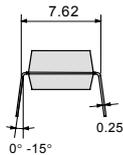
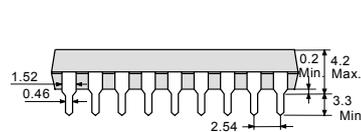
### Terminal connection/External dimensions

(Unit:mm)

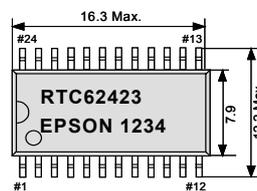
#### ● RTC-62421 (DIP 18-pin)



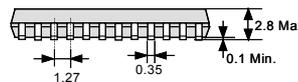
No.	Pin terminal	No.	Pin terminal
1	STD.P	18	VDD
2	/CS0	17	(VDD)
3	ALE	16	(VDD)
4	A0	15	CS1
5	A1	14	C0
6	A2	13	D1
7	A3	12	D2
8	/RD	11	D3
9	GND	10	/WR



#### ● RTC-62423 (SOP 24-pin)



No.	Pin terminal	No.	Pin terminal
1	STD.P	24	VDD
2	/CS0	23	(VDD)
3	N.C.	22	(VDD)
4	ALE	21	N.C.
5	A0	20	CS1
6	N.C.	19	D0
7	A1	18	N.C.
8	N.C.	17	N.C.
9	A2	16	D1
10	A3	15	D2
11	/RD	14	D3
12	GND	13	/WR



Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

### Specifications (characteristics)

\*Refer to application manual for details.

#### Absolute Max. rating

Item	Symbol	Condition	Min.	Max.	Unit
Supply voltage	VDD	Ta=+25 °C	-0.3	+7.0	V
Input voltage	VIO	Ta=+25 °C	GND-0.3	VDD+0.3	V
Storage temperature *	TSTG	RTC-62421	-55	+85	°C
		RTC-62423	-55	+125	°C

\*Stored as bare product after unpacking

#### Operating range

Item	Symbol	Condition	Min.	Max.	Unit
Power voltage	VDD	—	4.5	5.5	V
Clock voltage	VCLK	—	2.0	5.5	V
Operating temperature	TOPR	Stored as bare product after unpacking	-40	+85	°C

#### Frequency characteristics

Item	Symbol	Condition	Range	Unit
Frequency precision	Δf / f	Ta=+25 °C VDD=5.0 V	62421A	±10
			62421B	±50
			62423A	±20
			62423	±50
Frequency temperature characteristics	TOP	-10 °C to +70 °C (+25 °C)	+10 / -120	
		-40 °C to +85 °C (+25 °C)	+10 / -220	
Frequency voltage characteristics	f/V	Ta=+25 °C, VDD=4.5 V to 5.5 V	±5.0 Max.	×10 <sup>-6</sup> /V
Aging	fa	Ta=+25 °C, VDD=5.0 V, First year	±5.0 Max.	×10 <sup>-6</sup> /year

#### DC characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Applicable terminal
Current consumption	I <sub>DD1</sub> I <sub>DD2</sub>	CS1=0 V VDD=5 V VDD=2 V	—	15	30	μA	—
			—	1	1.8	μA	—
"H" input voltage (1)	V <sub>IH1</sub>	—	2.2	—	—	V	All inputs other than CS1
"L" input voltage (1)	V <sub>IL1</sub>	—	—	0.8	—	V	
"L" output voltage (1)	V <sub>OL1</sub>	I <sub>OL</sub> =2.5 mA	—	—	0.4	V	D0 to D3
"H" output voltage	V <sub>OH</sub>	I <sub>OH</sub> =400 μA	2.4	—	—	V	
"L" output voltage (2)	V <sub>OL2</sub>	I <sub>OL</sub> =2.5 mA	—	—	0.4	V	STD.P
OFF leak current	I <sub>OFFLK</sub>	V <sub>I</sub> =VDD/0 V	—	—	10/-10	μA	
Input capacity	C <sub>I</sub>	Input frequency 1 MHz	—	5	—	pF	Input Pins
"H" input voltage (2)	V <sub>IH2</sub>	VDD=2.0 V to 5.5 V	4/5 VDD	—	—	V	CS1
"L" input voltage (2)	V <sub>IL2</sub>		—	—	1/5 VDD	—	
Input leak current (1)	I <sub>LK1</sub>	V <sub>I</sub> =VDD/0 V	—	—	1/-1	μA	Input other than D0 to D3
Input leak current (2)	I <sub>LK2</sub>		—	—	10/-10	μA	

## 4-bit REAL TIME CLOCK MODULE

# RTC - 72421 / 72423

- Built-in crystal unit allows adjustment-free efficient operation.
- 24 h / 12 h changeable and leap year automatically adjustable (Gregorian calendar).
- Lead(Pb)-free : Contains high melting temperature type solder (Pb85 %) exempted by RoHS directive.



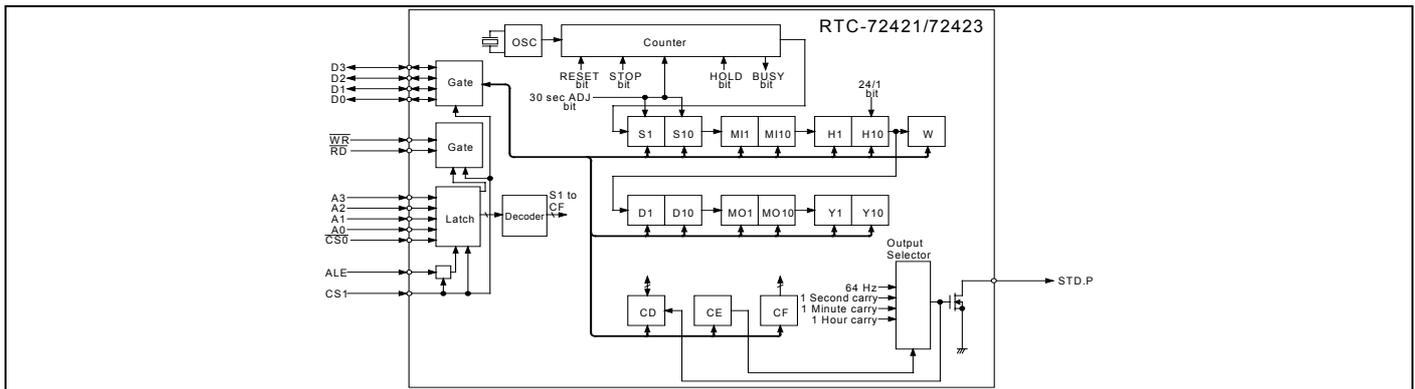
Actual size

RTC-72421

RTC-72423



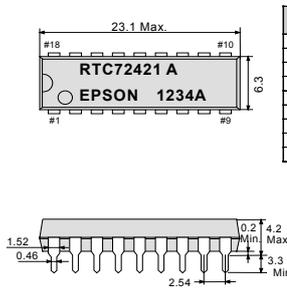
### Block diagram



### Terminal connection/External dimensions

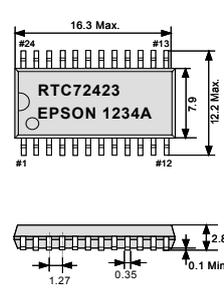
(Unit:mm)

● RTC-72421 (DIP 18-pin)



No.	Pin terminal	No.	Pin terminal
1	STD.P	18	VDD
2	/CS0	17	(VDD)
3	ALE	16	(VDD)
4	A0	15	CS1
5	A1	14	C0
6	A2	13	D1
7	A3	12	D2
8	/RD	11	D3
9	GND	10	/WR

● RTC-72423 (SOP 24-pin)



No.	Pin terminal	No.	Pin terminal
1	STD.P	24	VDD
2	/CS0	23	(VDD)
3	N.C.	22	(VDD)
4	ALE	21	N.C.
5	A0	20	CS1
6	N.C.	19	D0
7	A1	18	N.C.
8	N.C.	17	N.C.
9	A2	16	D1
10	A3	15	D2
11	/RD	14	D3
12	GND	13	/WR

Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

### Specifications (characteristics)

\*Refer to application manual for details.

#### Absolute Max. rating

Item	Symbol	Condition	Min.	Max.	Unit
Supply voltage	VDD	Ta=+25 °C	-0.3	+7.0	V
Input voltage	VIO	Ta=+25 °C	GND-0.3	VDD+0.3	V
Storage temperature *	TSTG	RTC-72421	-55	+85	°C
		RTC-72423	-55	+125	

\*Stored as bare product after unpacking

#### Operating range

Item	Symbol	Condition	Min.	Max.	Unit
Power voltage	VDD	—	4.5	5.5	V
Clock voltage	VCLK	—	2.0	5.5	
Operating temperature	TOPR	RTC-72421	-10	+70	°C
		RTC-72423	-40	+85	

Stored as bare product after unpacking

#### Frequency characteristics

Item	Symbol	Condition	Range	Unit
Frequency precision	Δf / f	Ta=+25 °C VDD=5.0 V	72421A	±10
			72421B	±50
			72423A	±20
			72423	±50
Frequency temperature characteristics	TOP	-10 °C to +70 °C (+25 °C)	+10 / -120	×10 <sup>-6</sup>
		-40 °C to +85 °C (+25 °C)	+10 / -220	
Frequency voltage characteristics	f/V	Ta=+25 °C, VDD=2.0 V to 5.5 V	±5.0 Max.	×10 <sup>-6</sup> /V
Aging	fa	Ta=+25 °C, VDD=5.0 V, First year	±5.0 Max.	×10 <sup>-6</sup> /year

#### DC characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Applicable terminal
Current consumption	IDD1	CS1=0 V Exclude input/output current	—	1	10	μA	—
	IDD2	VDD=5 V VDD=2 V	—	0.9	5		
"H" input voltage (1)	VIH1	—	2.2	—	—	V	All inputs other than CS1
"L" input voltage (1)	VIL1		0.8				
"L" output voltage (1)	VOL1	IOL=2.5 mA	—	—	0.4	V	D0 to D3
"H" output voltage	VOH	IOH=-400 μA	2.4	—	—		
"L" output voltage (2)	VOL2	IOL=2.5 mA	—	—	0.4	V	STD.P
OFF leak current	IoffLK	V1=VDD/0 V	—	—	10/-10		μA
Input capacity	C1	Input frequency 1 MHz	—	10	—	pF	Input other than D0 to D3
			—	20	—		D0 to D3, STD.P
"H" input voltage (2)	VIH2	VDD=2.0 V to 5.5 V	4/5 VDD	—	—	V	CS1
"L" input voltage (2)	VIL2		—	—	1/5 VDD		
Input leak current (1)	ILK1	V1=VDD/0 V	—	—	1/-1	μA	Input other than D0 to D3
Input leak current (2)	ILK2		—	—	10/-10		D0 to D3

Lined area for writing a memo.



# Filter

## ■ Monolithic Crystal Filter (MCF)

Applications	Frequency	Pole (Filter order)	Passband		Model	External dimension (mm)	Page.
	MHz		kHz	dB			
Radio Equipment / IF (For miniature size equipments)	130.05	2	±10.5	1	TF2-D0AD6	2.5×2.0×4.8	126~127
	130.05	3	±14	3	TS3-D0A31	3.8×3.8×1.0	
	183.6	3	±13	3	TF3-J3DC5	3.8×3.8×1.0	
	243.96	3	±130	3	TF3-Q3GC1		
Radio Equipment / IF	21.4	2	±7.5	3	TS2-21B01	7.0×5.0×1.3	128~129
	21.7	2	±7.5	3	TS2-21B02		
	45	2	±15	3	TS2-45A01		
		3			TS3-45A01		
	73.35	3	±6.5	3	TF3-73BA1		
		4	±7.5		TF4-73BA2		
Base Stations / IF(GSM)	71	4	±80	3	TF4-71GX2	26.0×16.0×5.0	130
RKE / RF 	310~320	2	±120	3	TF2-W1GC1	3.0×3.0×0.9	131

\*Models for other frequencies are available upon request.

## ■ SAW Filter

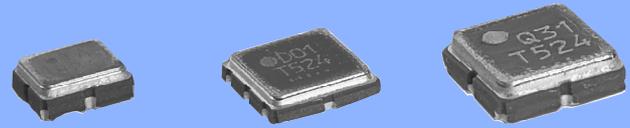
Application		Nominal frequency (MHz)	Passband (MHz)	Model	External dimension (mm)	Page.
TPMS, RKE/RF ARIB std.T67 in Japan/RF 	TPMS/RKE	315	1	TQS-570AA-7R	3.0×3.0×1.11	132-133
	ARIB T67	428	4	TQS-568AA-7R	3.8×3.8×1.25	
		429.55	0.8	TQS-830A-7R	5.2×4.5×1.55	
	RKE/TPMS/ARIB T67	300~500	0.2	FF-555	5.2×4.8×1.5	134
		300~500	0.4	FF-585	5.2×4.8×1.5	135
300~500		0.4(0.6)	FF-32N	3.8×3.8×0.98	136	
ISM/RF	Europ	433.92	1.74	TQS-566AA-7R	3.0×3.0×1.11	137
		869	2	TQS-557AA-7R	3.0×3.0×1.11	
	North America	915	26	TQS-542AA-7R	3.0×3.0×1.11	
GPS, Car navigatio/RF		1575.42	2	TQS-537AB-7G	2.5×2.0×0.8	138-139
		1575.42	2.4	TQS-949AD-7G	2.5×2.0×0.8	
		1575.42	4	TQS-954EA-7R	2.5×2.0×1.15	
W-LAN/IF		374	17	TQS-457A-7R	5.2×4.5×1.55	140
		374	17	TQS-471BB-7R	3.0×3.0×1.11	
Cordless telephone/RF		903.5/926.5	2	TQS-879A-7R	3.8×3.8×1.25	141
Cellular phone, Telematics/RF	AMPS/TDMA/CDMA/Telematics	836.5	25	TQS-530S-7G	2.5×2.0×0.8	142-143
		881.5	25	TQS-516EA-7G	2.5×2.0×0.8	
		881.5	25	TQS-535AB-7G	2.5×2.0×0.8	
	W-CDMA/Telematics	906	38	TQS-539A-7G	2.5×2.0×0.8	
Cellular phone/IF	CDMA	183.6	1.23	TQS-465AA-7R	6.0×3.5×1.15	144-145
		183.6	0.022	TQS-663AA-7R	7.0×5.0×1.57	
	W-CDMA/UMTS	190	4.6	TQS-477AA-7R	3.0×3.0×1.11	
Base station/IF	W-CDMA Base Station	380	4.4	TQS-472BA-7R	7.0×5.0×1.5	146
		190	4.4	TQS-474AA-7R	7.0×5.0×1.5	

RKE : Remote Keyless Entry

**CRYSTAL FILTER  
FOR MINIATURE SIZE RADIO EQUIPMENT/ IF**

**TF2-D0AD6  
TS3-D0A31  
TF3-J3DC5 / -Q3GC1**

- High frequency and outstanding mechanical strength with original inverted-mesa structure.
- High frequency 3 pole filters with original process technology.
- Applications : Various kinds of miniature size radio equipment
- Lead(Pb)-free : Lead free completely



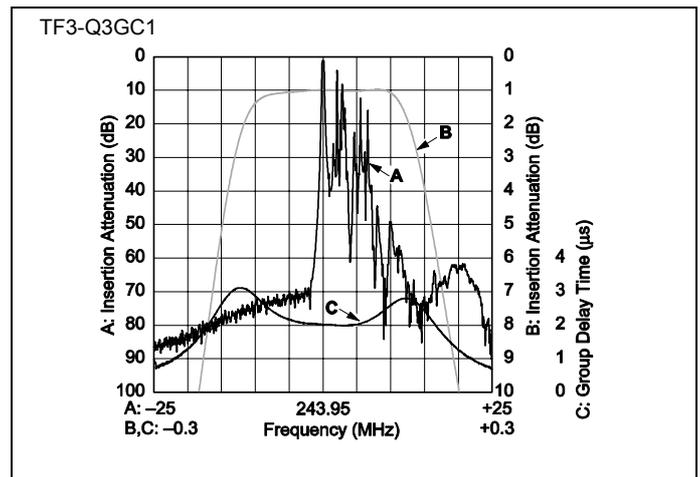
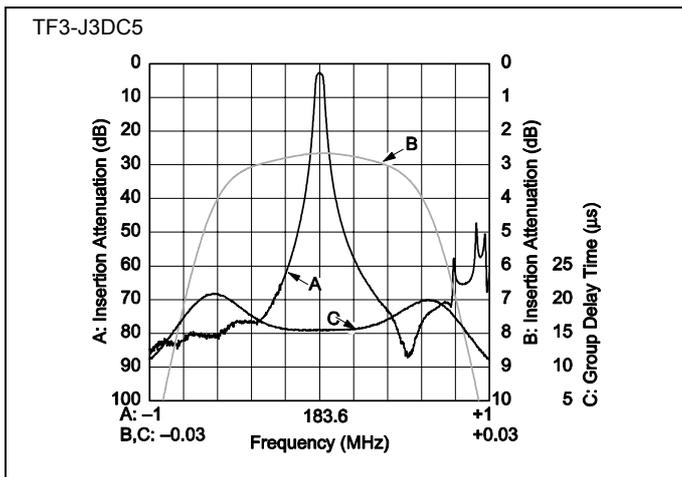
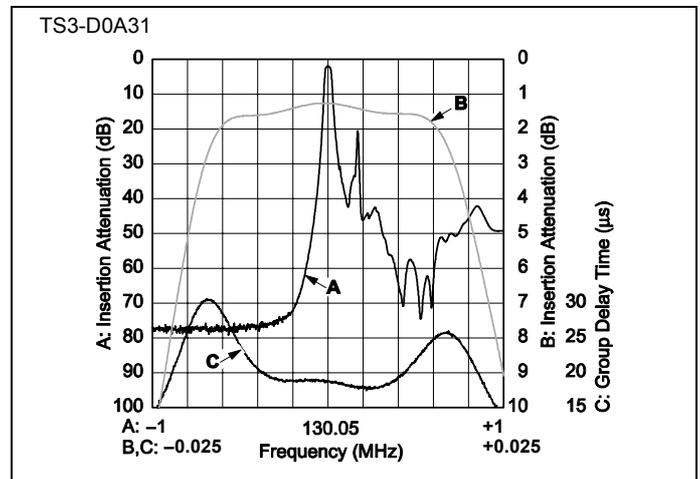
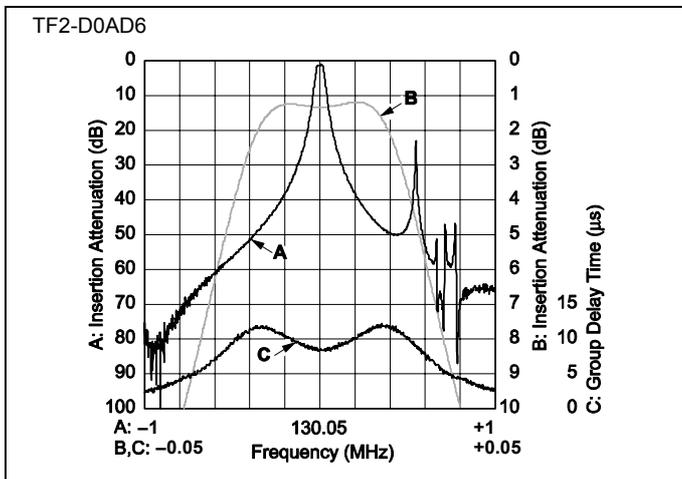
Actual size



**Specifications (characteristics)**

Item	Symbol	TF2-D0AD6	TS3-D0A31	TF3-J3DC5	TF3-Q3GC1
Nominal frequency	$f_0$	130.05 MHz	130.05 MHz	183.6 MHz	243.96 MHz
Storage temperature range	$T_{stg}$	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C
Operating temperature range	$T_{use}$	-30 °C to +85 °C	-30 °C to +85 °C	-30 °C to +85 °C	-30 °C to +85 °C
Number of poles		2	3	3	3
Passband	BW	$f_0 \pm 10.5$ kHz Min. (1 dB down)	$f_0 \pm 14$ kHz Min. (3 dB down)	$f_0 \pm 13$ kHz Min. (3 dB down)	$f_0 \pm 130$ kHz Min. (3 dB down)
Insertion loss	IL	3 dB Max.	3 dB Max.	4.5 dB Max.	3 dB Max.
Ripple	Ri	1 dB Max.	1 dB Max.	1 dB Max.	1 dB Max.
Stop band attenuation		$f_0 \pm 50$ kHz Max. (10 dB down)	$f_0 \pm 50$ kHz Max. (20 dB down)	$f_0 \pm 60$ kHz Max. (20 dB down)	$f_0 \pm 600$ kHz Max. (20 dB down)
Attenuation	ATT	70 dB Min. ( $f_0 - 900$ kHz)	70 dB Min. ( $f_0 - 800$ kHz to $f_0 - 1000$ kHz)	60 dB Min. ( $f_0 - 330$ kHz to $f_0 - 660$ kHz)	—
Terminating impedance	Z	200 $\Omega$ // 1.7 pF	950 $\Omega$ // 1.2 pF	150 $\Omega$ // 0.8 pF	800 $\Omega$ // 0.8 pF
Package		TS-2520	TS-38	TS-30	TS-30

**Electrical DATA**

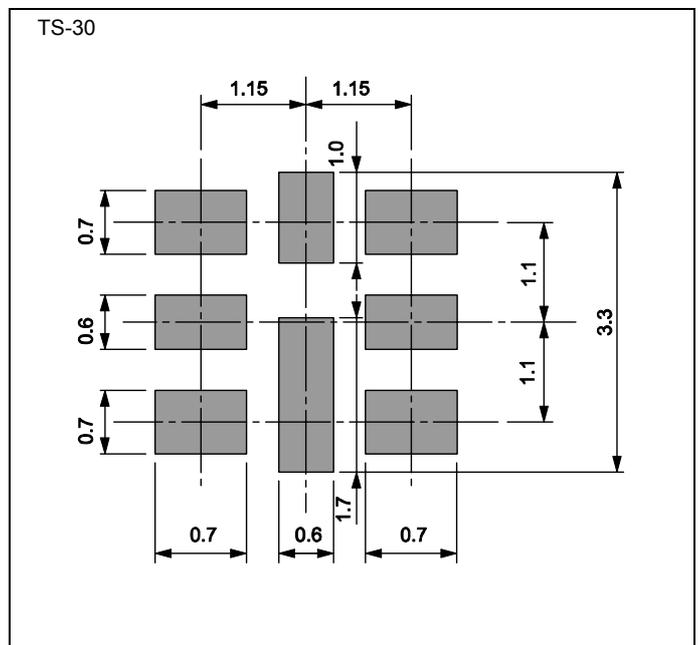
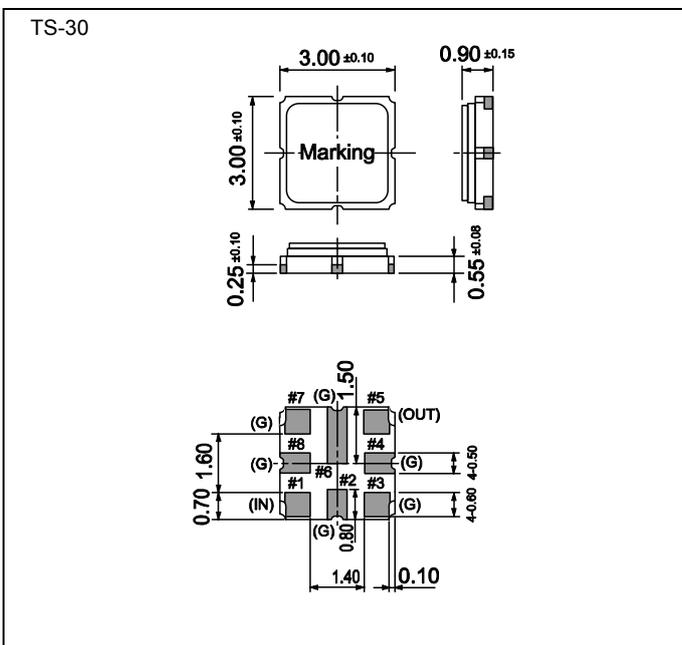
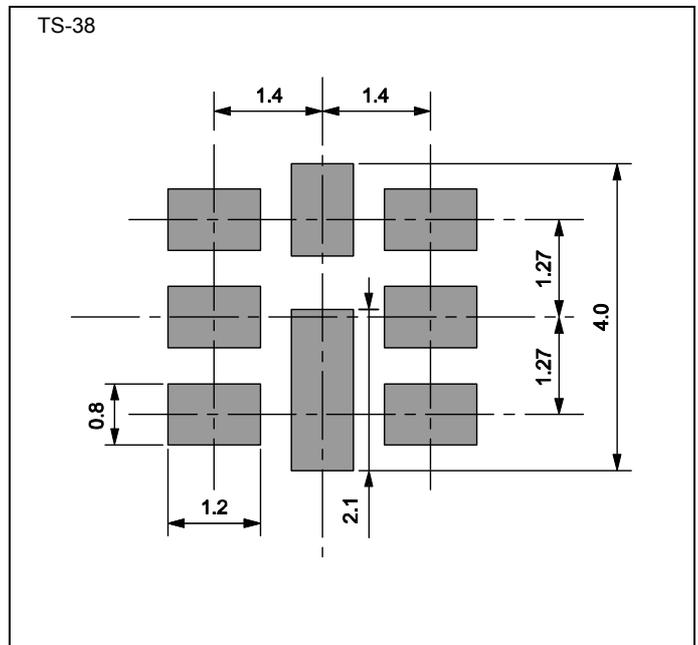
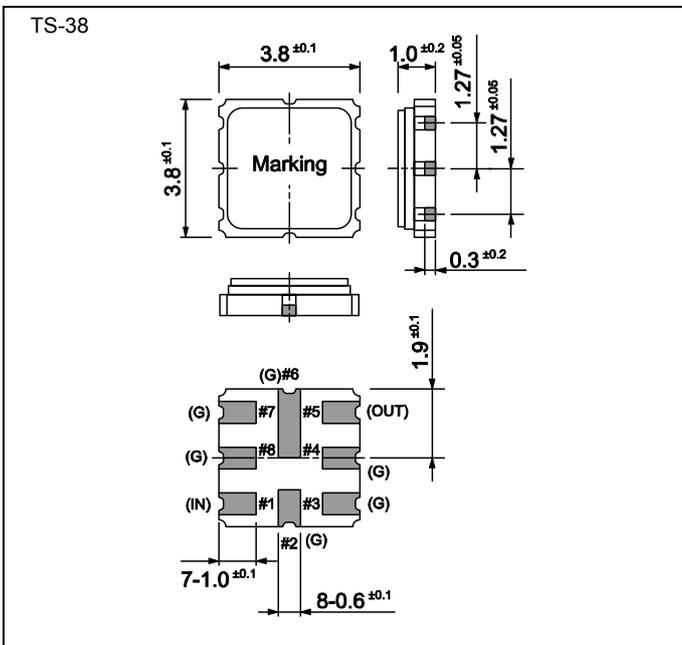
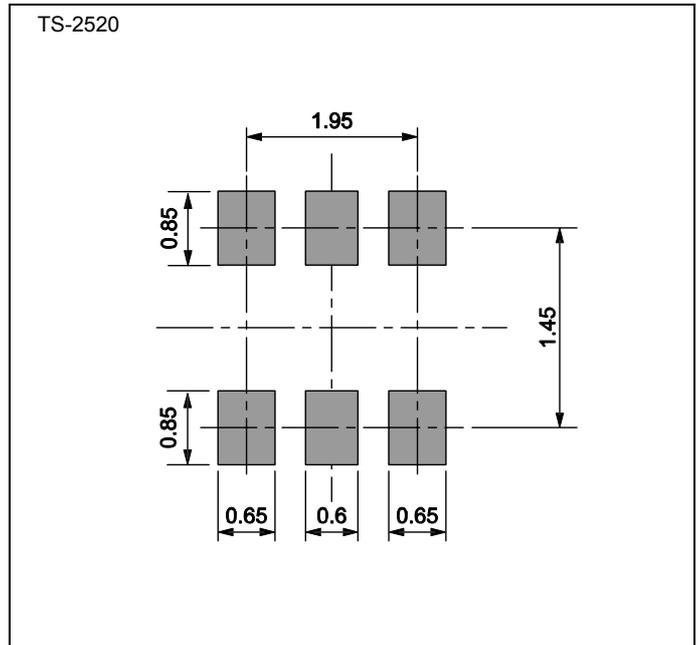
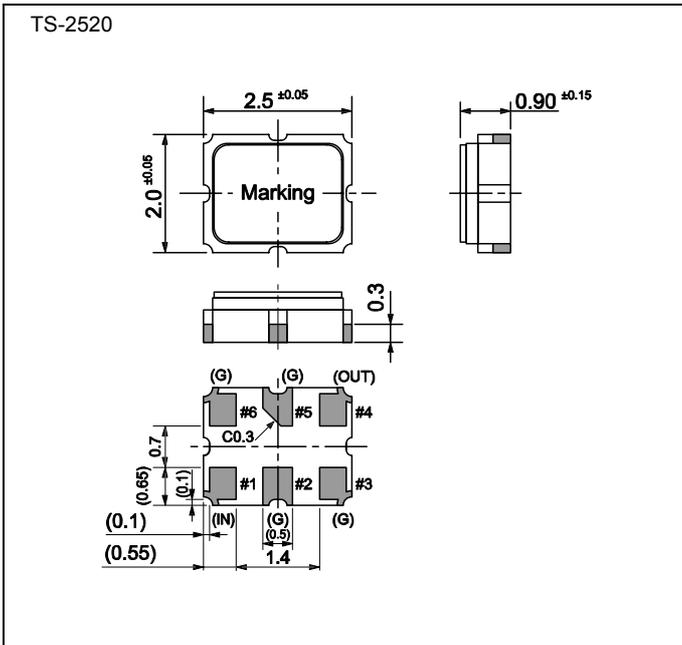


**External dimensions**

(unit :mm)

**Footprint (Recommended)**

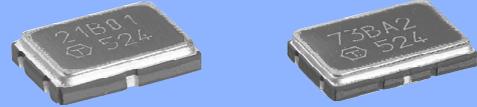
(unit :mm)



**CRYSTAL FILTER  
FOR RADIO EQUIPMENT / IF**

**TS2-21B01/-21B02/-45A01  
TS3-45A01  
TF3-73BA1  
TF4-73BA2**

- Superb attenuation with 4 pole filters.
- Applications : Various kinds of radio equipment
- Lead(Pb)-free : Lead free completely



Actual size

TS-75A

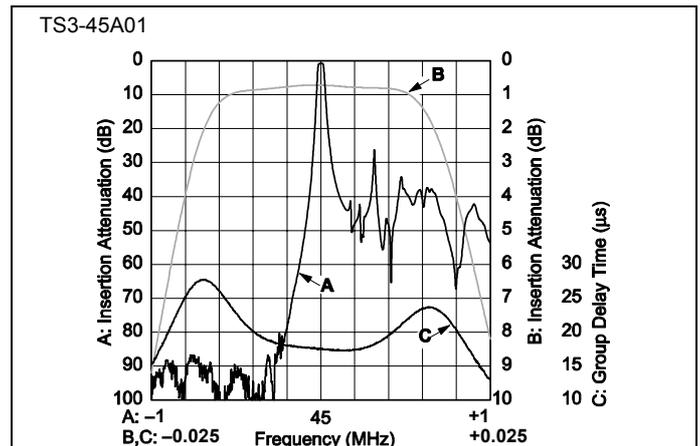
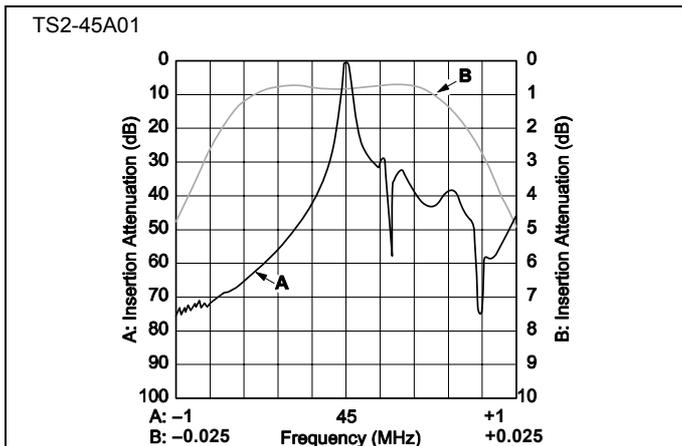
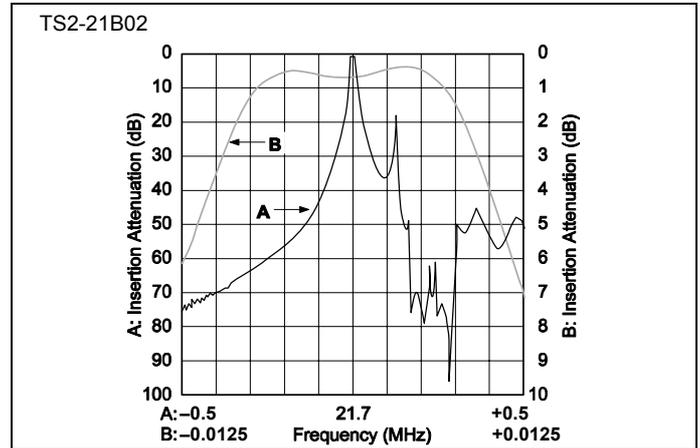
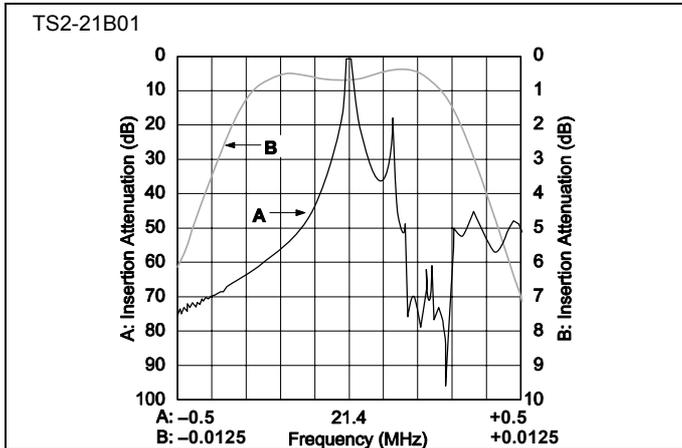
TS-75B



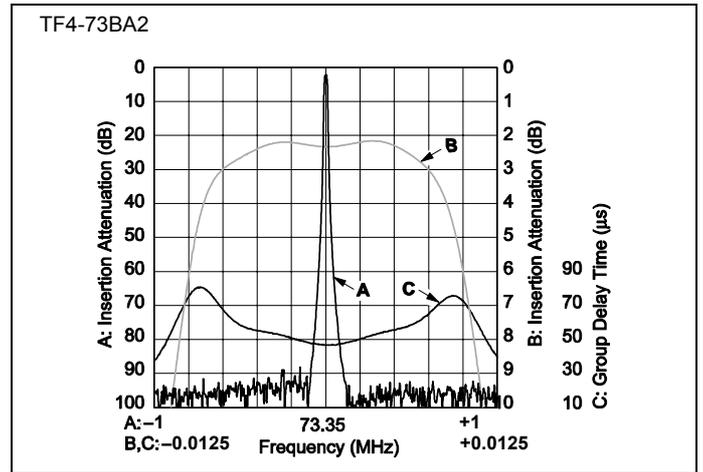
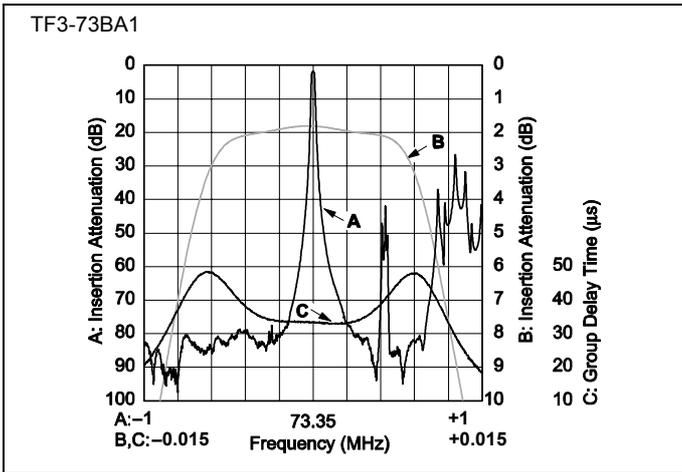
**Specifications (characteristics)**

Item	Symbol	TS2-21B01	TS2-21B02	TS2-45A01	TS3-45A01	TF3-73BA1	TF4-73BA2
Nominal frequency	$f_0$	21.4 MHz	21.7 MHz	45 MHz	45 MHz	73.35 MHz	73.35 MHz
Storage temperature range	$T_{stg}$	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C
Operating temperature range	$T_{use}$	-30 °C to +85 °C	-30 °C to +85 °C	-30 °C to +85 °C	-30 °C to +85 °C	-30 °C to +85 °C	-30 °C to +85 °C
Number of poles	—	2	2	2	3	3	4
Passband	BW	$f_0 \pm 7.5$ kHz Min. (3 dB down)	$f_0 \pm 7.5$ kHz Min. (3 dB down)	$f_0 \pm 15$ kHz Min. (3 dB down)	$f_0 \pm 15$ kHz Min. (3 dB down)	$f_0 \pm 6.5$ kHz Min. (3 dB down)	$f_0 \pm 7.5$ kHz Min. (3 dB down)
Insertion loss	IL	2 dB Max.	2 dB Max.	3 dB Max.	3 dB Max.	4 dB Max.	5 dB Max.
Ripple	Ri	1 dB Max.	1 dB Max.	1 dB Max.	1 dB Max.	1 dB Max.	1 dB Max.
Stop band attenuation	—	$f_0 \pm 25$ kHz Max. (15 dB down)	$f_0 \pm 25$ kHz Max. (15 dB down)	$f_0 \pm 50$ kHz Max. (15 dB down)	$f_0 \pm 50$ kHz Max. (20 dB down)	$f_0 \pm 25$ kHz Max. (18 dB down)	$f_0 \pm 25$ kHz Max. (30 dB down)
Attenuation	ATT	70 dB Min. ( $f_0 - 910$ kHz)	70 dB Min. ( $f_0 - 910$ kHz)	70 dB Min. ( $f_0 - 800$ kHz to $f_0 - 1000$ kHz)	70 dB Min. ( $f_0 - 800$ kHz to $f_0 - 1000$ kHz)	70 dB Min. ( $f_0 - 800$ kHz to $f_0 - 1000$ kHz)	80 dB Min. ( $f_0 - 800$ kHz to $f_0 - 1000$ kHz)
Terminating impedance	Z	1500 $\Omega$ // 2.5 pF	1500 $\Omega$ // 2.5 pF	1100 $\Omega$ // 0 pF	1200 $\Omega$ // -1.0 pF	400 $\Omega$ // -1.2 pF	500 $\Omega$ // +3.5 pF
Package	—	TS-75A	TS-75A	TS-75A	TS-75A	TS-75A	TS-75B

**Electrical DATA**

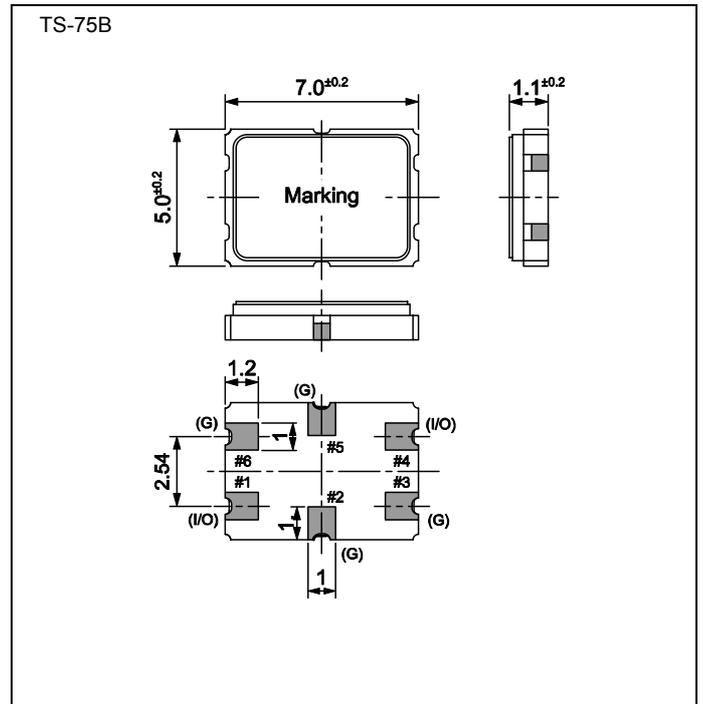
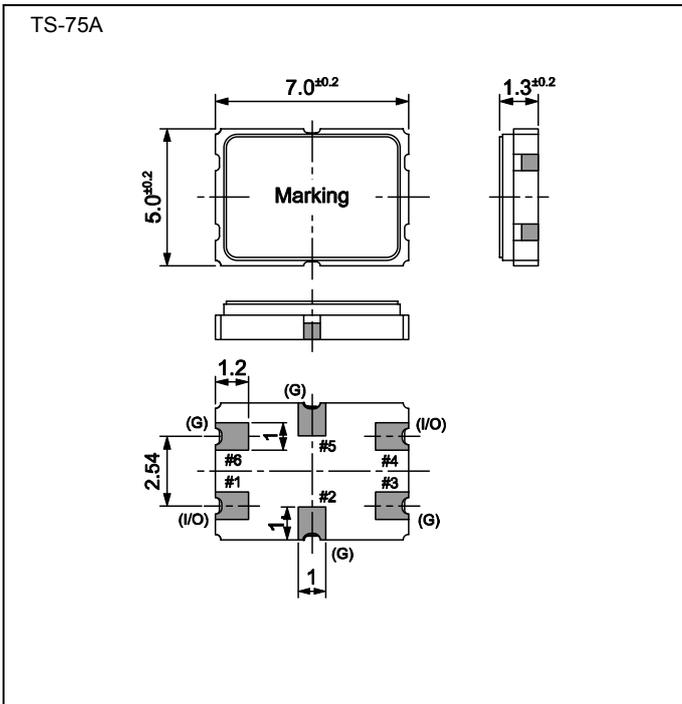


Electrical DATA



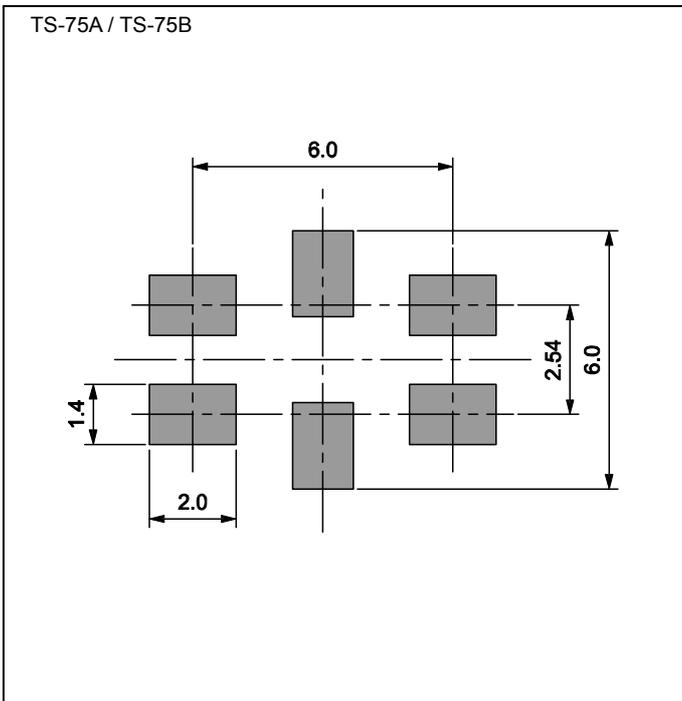
External dimensions

(Unit : mm)



Footprint (Recommended)

(Unit : mm)



**CRYSTAL FILTER  
FOR BASE STATION / IF**

**TF4-71GX2**

- High stability for external impedance with matching circuit.
- Applications : Base station for mobile phones
- Lead(Pb)-free : Lead free completely



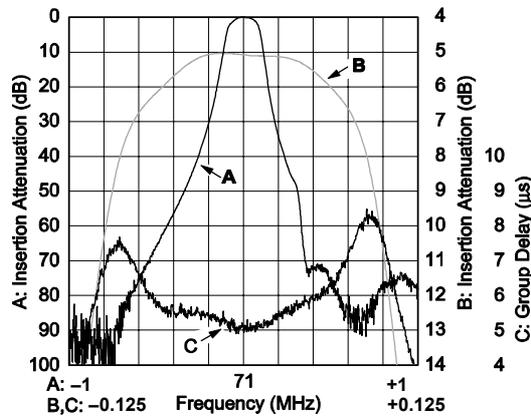
Actual size



**Specifications (characteristics)**

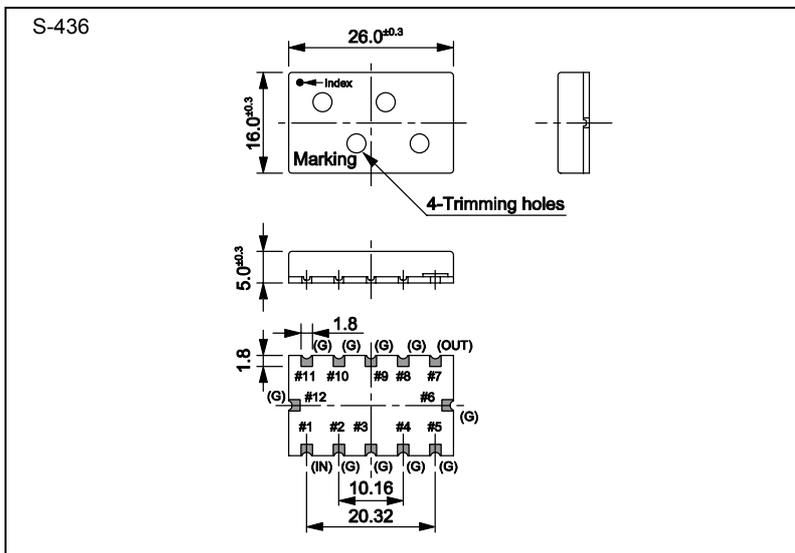
Item	Symbol	Specification
Nominal Frequency	$f_0$	71 MHz
Storage temperature range	T_stg	-40 °C to +85 °C
Operating temperature range	T_use	0 °C to +70 °C
Number of poles	—	4
Passband	BW	$f_0 \pm 80$ kHz Min. (3 dB down)
Insertion loss	IL	6 dB Max.
Ripple	Ri	1 dB Max.
Stop band attenuation	—	$f_0 \pm 200$ kHz Max. (28 dB down)
Attenuation	ATT	70 dB Min. ( $f_0 - 800$ kHz)
Terminating impedance	Z	50 $\Omega$ // 0 pF
Package	—	S-436

**Electrical DATA**



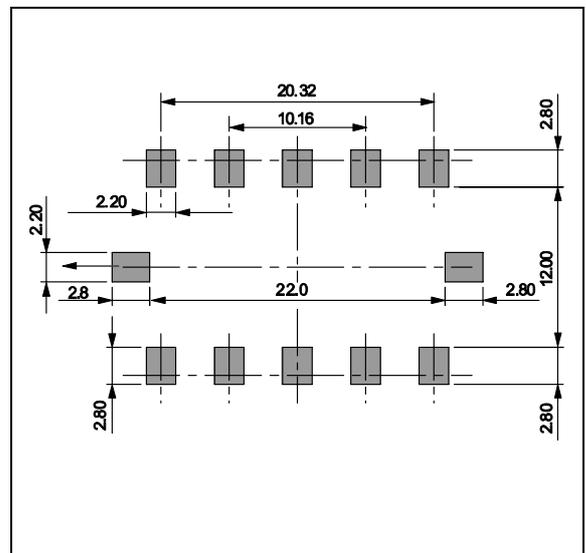
**External dimensions**

(Unit : mm)



**Footprint (Recommended)**

(Unit : mm)



# CRYSTAL FILTER FOR REMOTE KEYLESS ENTRY / RF

## TF2-W1GC1

- High fundamental mode frequency and outstanding mechanical strength with internally developed inverted-mesa structure.
- Applications : Remote keyless entry, Low-power application
- Lead(Pb)-free : Lead free completely



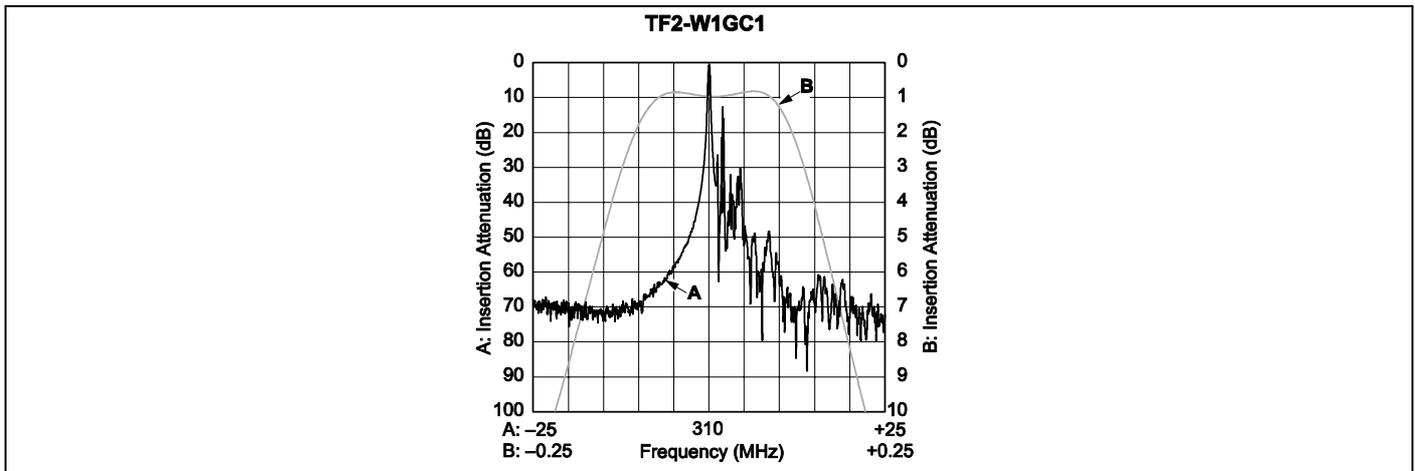
Actual size



### Specifications (characteristics)

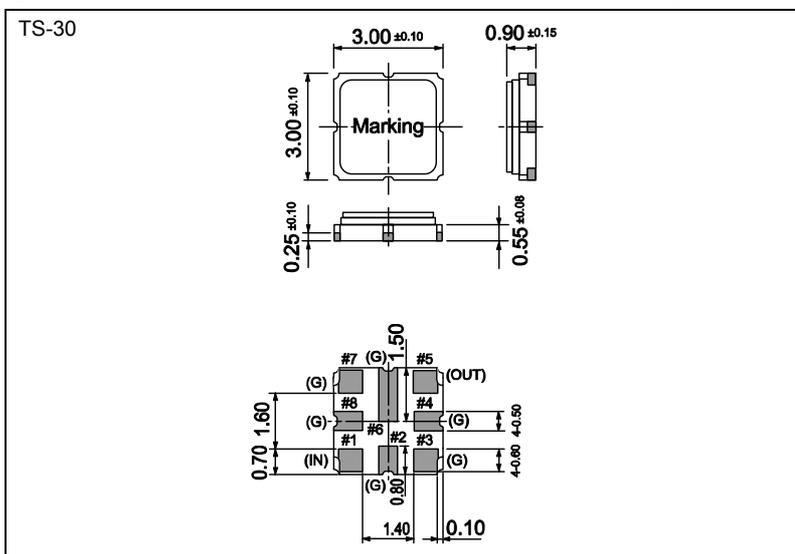
Item	Symbol	Specification
Nominal frequency range	$f_0$	310 MHz to 320 MHz
Storage temperature range	$T_{stg}$	-40 °C to +85 °C
Operating temperature range	$T_{use}$	-40 °C to +85 °C
Number of poles	—	2
Passband	BW	$f_0 \pm 120$ kHz Min. (3 dB down)
Insertion loss	IL	3 dB Max.
Ripple	Ri	1 dB Max.
Stop band attenuation	—	$f_0 \pm 910$ kHz Max. (15 dB down)
Attenuation	ATT	45 dB Min. ( $f_0 \pm 21.4$ MHz)
Terminating impedance	Z	400 $\Omega$ // 0 pF
Package	—	TS-30

### Electrical DATA



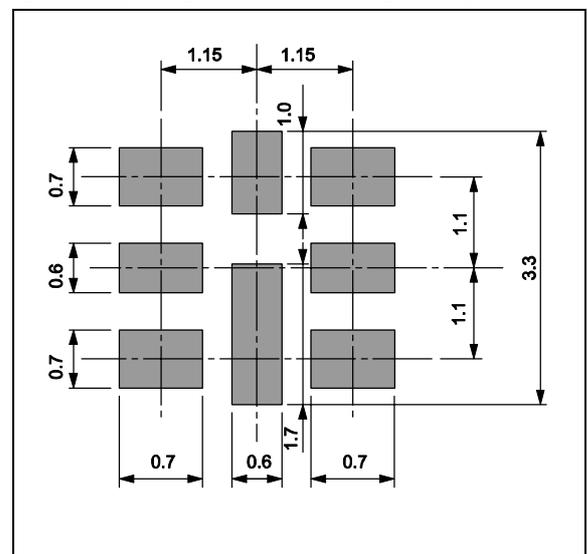
### External dimensions

(Unit : mm)



### Footprint (Recommended)

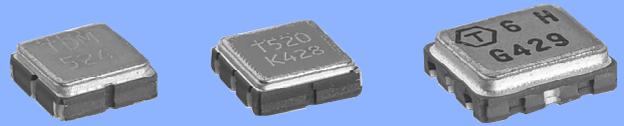
(Unit : mm)



## SAW FILTER FOR TPMS, RKE, Japan ARIB std. T67 / RF

### TQS-570AA-7R TQS-568AA-7R TQS-830A-7R

- Narrow band type with good selectivity and wide band type covering 426MHz and 429MHz bands are available.
- Lead(Pb)-free : Lead free completely



Actual size

TQS-570AA-7R



TQS-568AA-7R



TQS-830A-7R

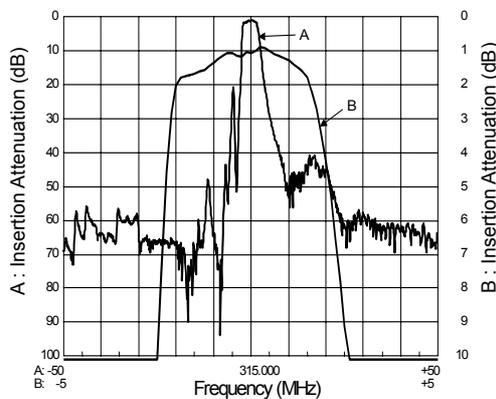


### Specifications (characteristics)

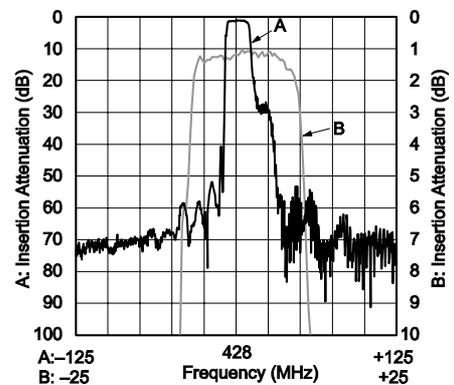
Item	Symbol	TQS-570AA-7R	TQS-568AA-7R	TQS-830A-7R
Nominal frequency	$f_0$	315 MHz	428 MHz	429.55 MHz
Storage temperature range	$T_{stg}$	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C
Operating temperature range	$T_{use}$	-40 °C to +85 °C	-30 °C to +85 °C	-10 °C to +50 °C
Passband	BW	314.5 to 315.5 MHz	426 to 430 MHz	429.15 to 429.95 MHz
Insertion loss	IL	2.5 dB Max. (IL in passband)	2.0 dB Max. (IL in passband)	3.5 dB Max. (IL in passband)
Ripple	Ri	1.5 dBp-p Max.	1.0 dBp-p Max.	—
VSWR	—	2.3 Max.	2.0 Max.	—
Stop band attenuation (relative to through level)	—	DC to 295 MHz : 50 dB Min. 295 to 305 MHz : 40 dB Min. 325 to 336 MHz : 35 dB Min. 336 to 1000 MHz : 40 dB Min.	DC to 388 MHz : 50 dB Min. 404 to 409 MHz : 45 dB Min. 478 to 1000 MHz : 45 dB Min. 1000 to 1500 MHz : 30 dB Min.	$f_0 \pm 42.4$ MHz : 55 dB Min.
Terminating impedance	Z	50 $\Omega$ (Unbalanced)	50 $\Omega$ (Unbalanced)	50 $\Omega$ (Unbalanced)
Package	—	SS-30S1(G)	SS-38S1(A)	SS-541(F)

### Electrical DATA

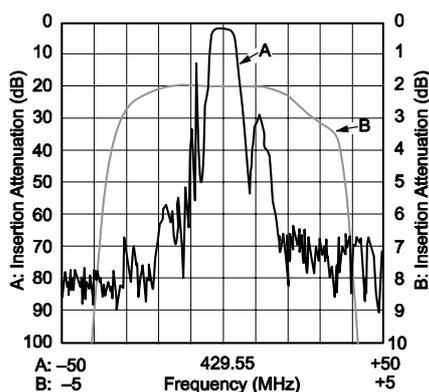
TQS-570AA-7R



TQS-568AA-7R

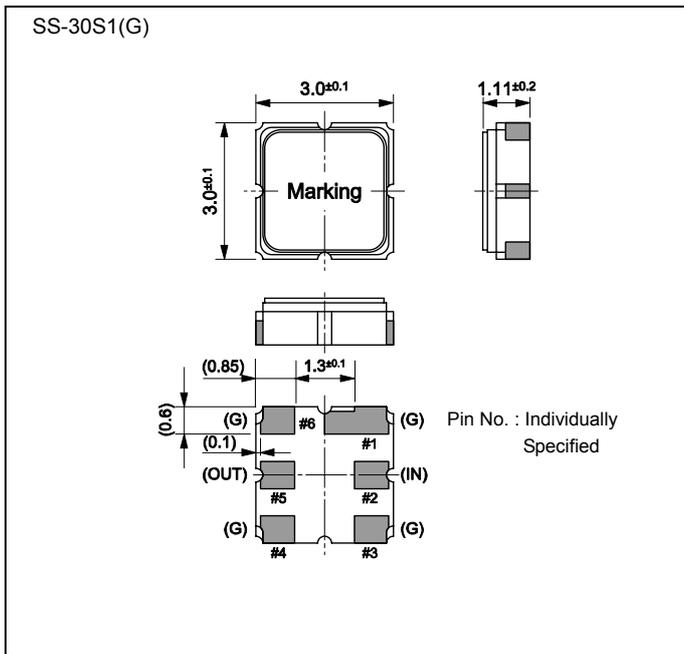


TQS-830A-7R



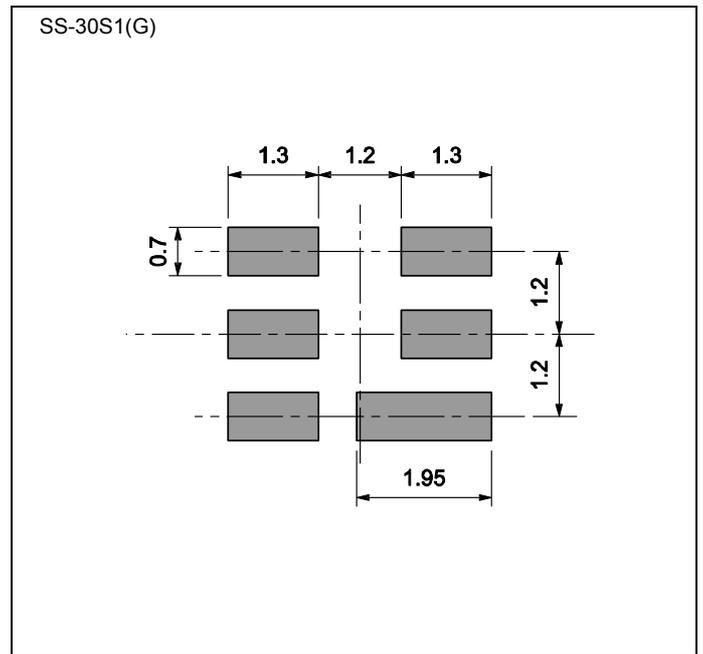
External dimensions

(Unit :mm)

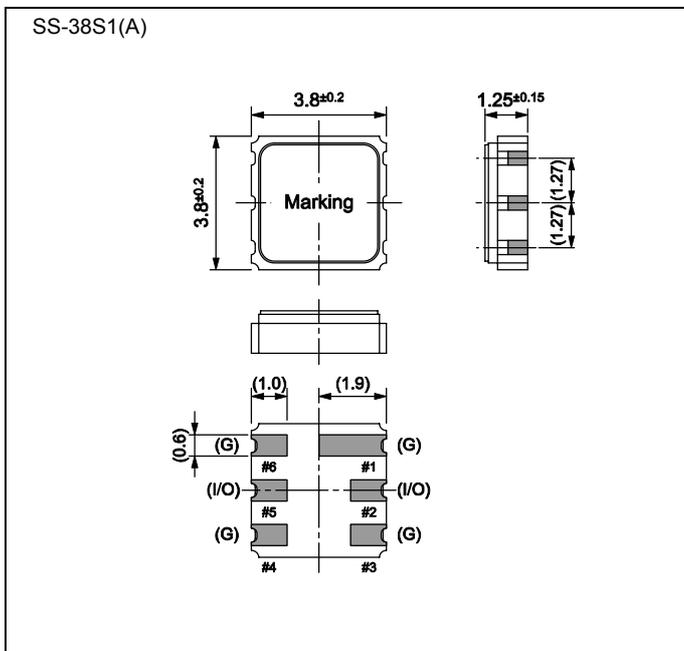


Footprint (Recommended)

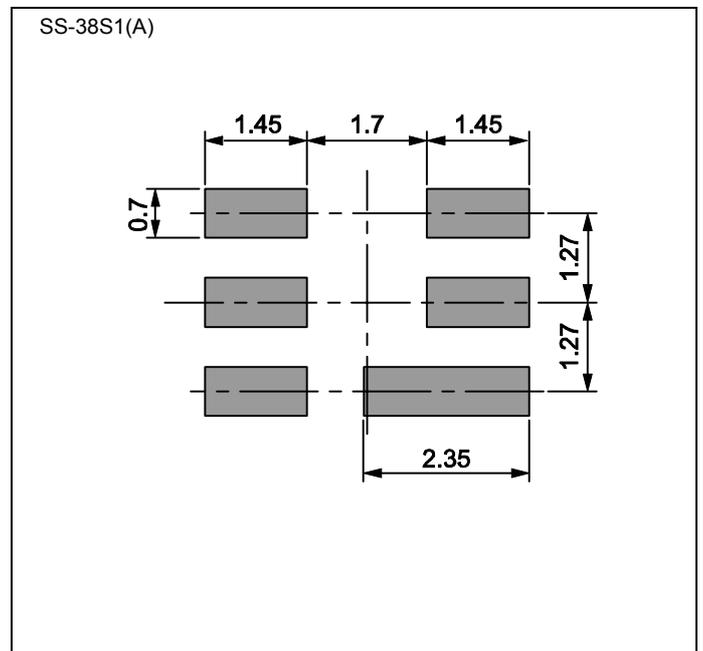
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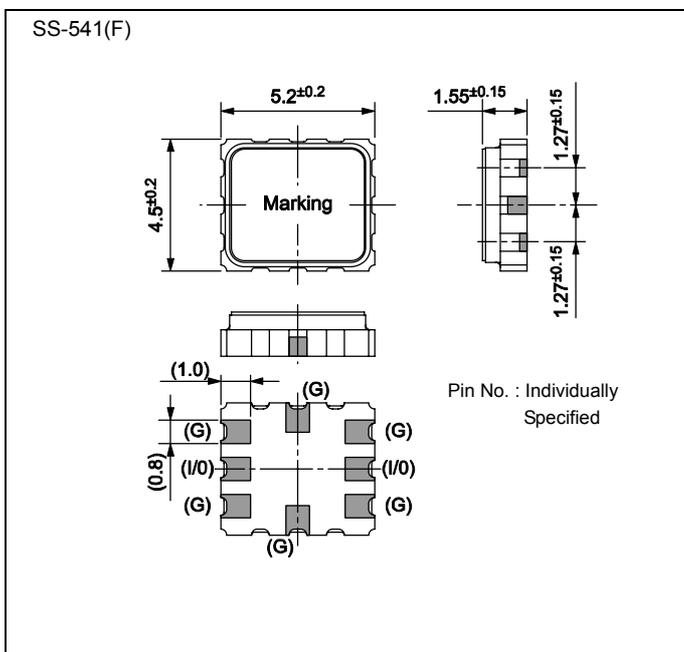
SS-38S1(A)



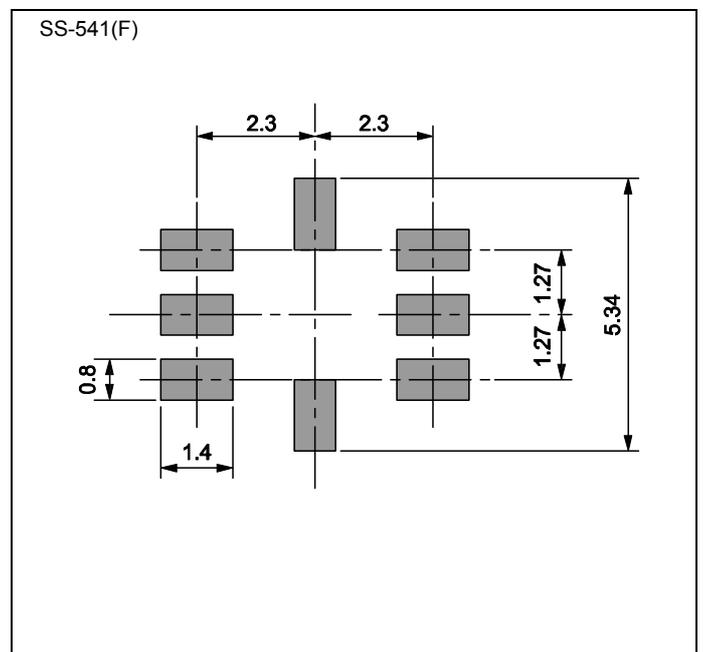
SS-38S1(A)



SS-541(F)



SS-541(F)



## SAW FILTER

## FF - 555

- Frequency range : 300 MHz to 500 MHz
- Thickness : 1.5 mm Typ.
- Applications : Wireless remote-control, Security (Automotive keyless entry)
- Lead(Pb)-free : Lead free completely
- Excellent shock resistance and environmental capability (prevention for contamination)
- Low-loss, Narrow Pass bandwidth, High stability by using crystal substrate.



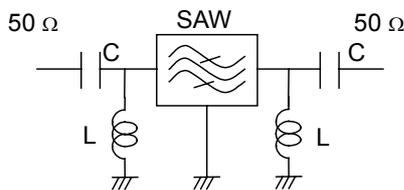
Actual size



## Specifications (characteristics)

Item	Symbol	Specifications	Remarks	
Nominal frequency range	$f_0$	300 MHz to 500 MHz		
Temperature range	Storage temperature	$T_{stg}$	-55 °C to +125 °C	Stored as bare product after unpacking
	Operating temperature	$T_{use}$	-40 °C to +85 °C	
Insertion Loss	IL	3.5 dB Max.	Minimum Loss	
Passband	BW	$f_0 \pm 100$ kHz Min.	Reference to Through level (3.5 dB down)	
Attenuation	ATT	At $f_0 - 21.4$ MHz 40 dB Min. At $f_0 + 10.7$ MHz 40 dB Min.	Reference to Through level	
Turnover temperature	$T_i$	+25 °C $\pm$ 15 °C		
Temperature coefficient	b	$-(3.4 \pm 0.8) \times 10^{-8} / ^\circ\text{C}^2$		
Terminal impedance	Z	370 $\Omega$ Typ.	Ex : 315 MHz	
		160 $\Omega$ Typ.	Ex : 433.92 MHz	

## Test fixture



## Remarks

Ex:  $f_0=315$  MHz  
 $C=4$  pF  
 $L=33$  nH

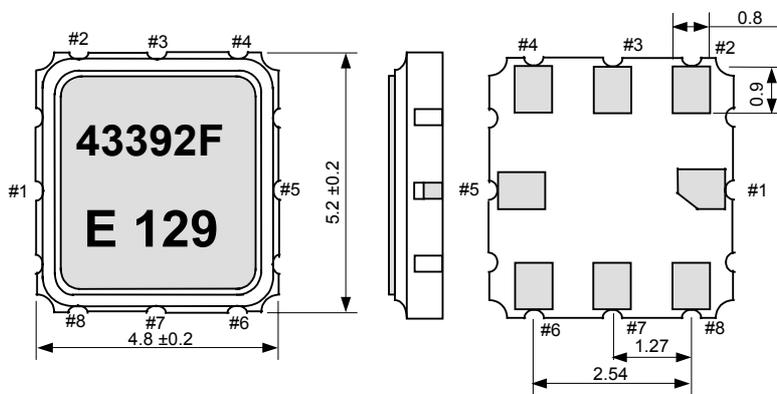
Ex:  $f_0=433.92$  MHz  
 $C=5$  pF  
 $L=18$  nH

## External dimensions

(Unit:mm)

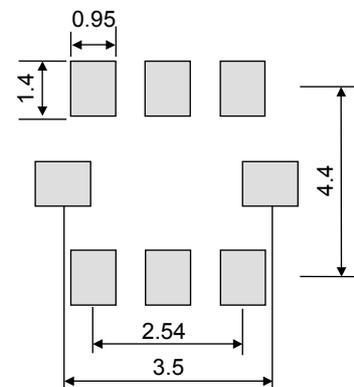
## Footprint (Recommended)

(Unit:mm)



## Pin map

Pin	Connection
3,7	IN, OUT
4,8	N.C.
1,2,5,6	GND



## SAW FILTER FOR TPMS

### FF - 585

- Frequency range : 300 MHz to 500 MHz
- Thickness : 1.5 mm Typ.
- Applications : Safety system(Automotive TPMS)  
Wireless remote-control  
Automotive keyless entry
- Lead(Pb)-free : Lead free completely
- Excellent shock resistance and environmental capability (prevention for contamination)
- Low-loss, Narrow Pass bandwidth, High stability by using crystal substrate.



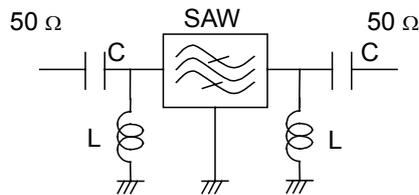
Actual size



### Specifications (characteristics)

Item	Symbol	Specifications	Remarks	
Nominal frequency range	$f_0$	300 MHz to 500 MHz		
Temperature range	Storage temperature	$T_{stg}$	-55 °C to +125 °C	Stored as bare product after unpacking
	Operating temperature	$T_{use}$	-40 °C to +85 °C	
Insertion Loss	IL	3.5 dB Max.	Minimum Loss	
Passband	BW	$f_0 \pm 200$ kHz Min.	Reference to minimum loss (3.5 dB down)	
Attenuation	ATT	At $f_0 + 21.4$ MHz 40 dB Min. At $f_0 - 21.4$ MHz 40 dB Min.	Reference to Through level	
Turnover temperature	$T_i$	+25 °C $\pm 15$ °C		
Temperature coefficient	b	$-(3.4 \pm 0.8) \times 10^{-8} / ^\circ\text{C}^2$		
Terminal impedance	Z	370 $\Omega$ Typ.	Ex : 315 MHz	
		160 $\Omega$ Typ.	Ex : 433.92 MHz	

### Test fixture



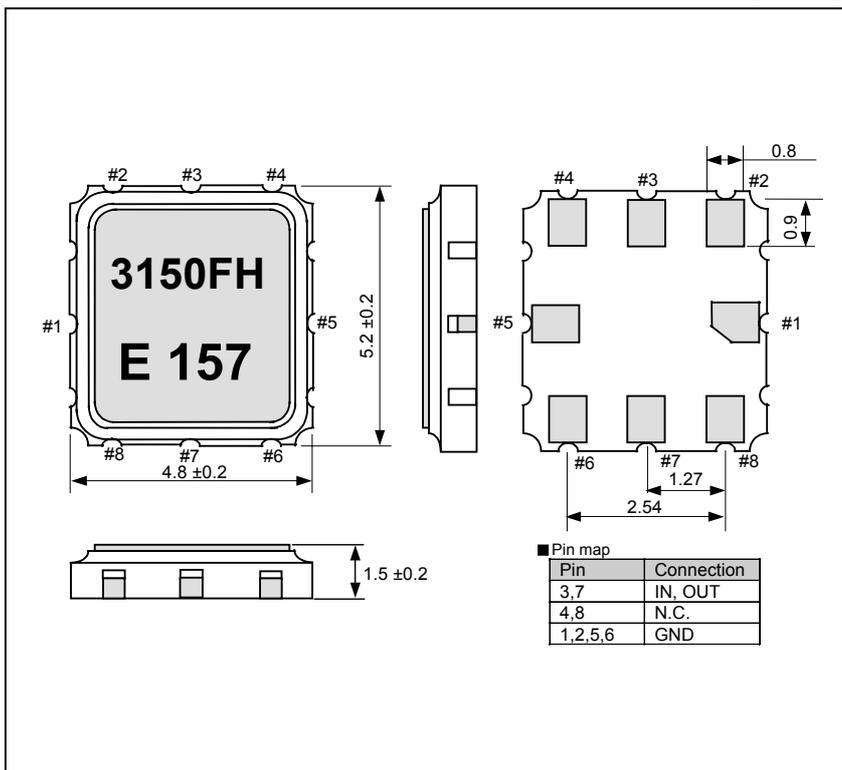
#### Remarks

Ex: $f_0=315$  MHz  
C=4 pF  
L=33 nH

Ex: $f_0=433.92$  MHz  
C=5 pF  
L=18 nH

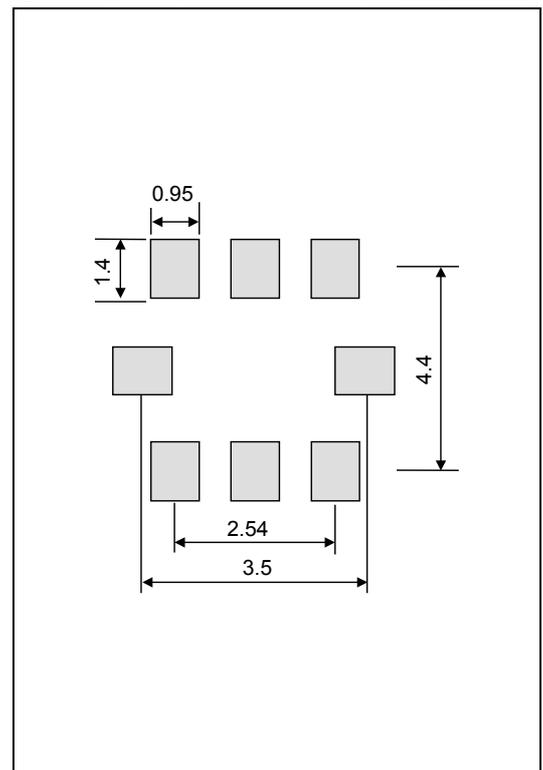
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



SAW FILTER

FF-32N

- Frequency range : 300 MHz to 500 MHz
- Thickness : 0.98 mm Typ.
- Applications : Wireless remote-control, Security (Automotive keyless entry, ARIB std. T67 in Japan)
- Lead(Pb)-free : Lead free completely
- Filter of low impedance by an original design.
- Low-loss, Narrow Pass bandwidth, High stability by using crystal substrate.



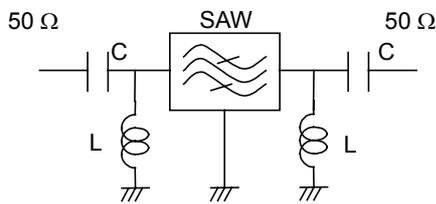
Actual size



Specifications (characteristics)

Item	Symbol	Specifications		Remarks	
Nominal frequency range	f <sub>0</sub>	300 MHz to 500 MHz	426 MHz, 429 MHz band*	*ARIB std. T67 in Japan	
Temperature range	Storage temperature	TSTG	-55 °C to +125 °C	-55 °C to +125 °C	Stored as bare product after unpacking
	Operating temperature	TOPR	-40 °C to +85 °C	-10 °C to +60 °C	
Insertion Loss	IL	3.5 dB Max.	3.5 dB Max.	Minimum Loss	
Passband	BW	f <sub>0</sub> ±200 kHz Min.	f <sub>0</sub> ±300 kHz Min.	Reference to minimum loss (3 dB down)	
Attenuation	ATT	f <sub>0</sub> -21.4 MHz : 40 dBMin. f <sub>0</sub> -10.7 MHz : 35 dBMin.	f <sub>0</sub> -21.4 MHz : 40 dB Min. f <sub>0</sub> -10.7 MHz : 35 dB Min.	Reference to minimum loss	
Turnover temperature	T <sub>i</sub>	+25 °C ±15 °C	+25 °C ±15 °C		
Temperature coefficient	b	-(3.4±0.8) × 10 <sup>-8</sup> / °C <sup>2</sup>	-(3.4±0.8) × 10 <sup>-8</sup> / °C <sup>2</sup>		
Terminal impedance	Z	370 Ω Typ.		Ex: 315 MHz	
		160 Ω Typ.		Ex: 433.92 MHz	
			220 Ω Typ.	Ex: 429.45 MHz	

Test fixture



Remarks

Ex: f<sub>0</sub>=315 MHz  
 Series Capacitance = 4 pF  
 Parallel Inductance =33 nH  
  
 Ex: f<sub>0</sub> =433.92 MHz  
 Series Capacitance =5 pF  
 Parallel Inductance =18 nH

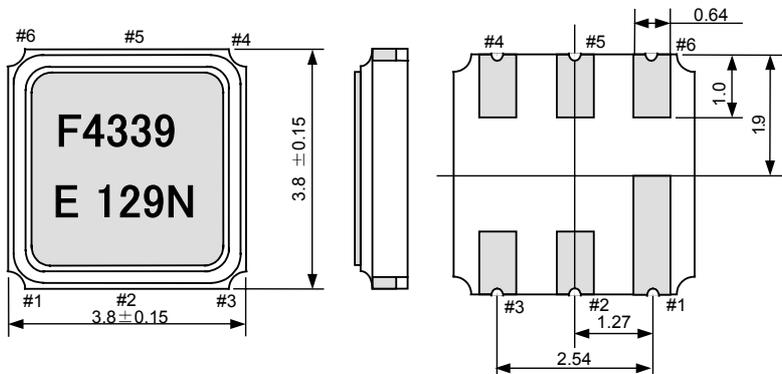
Ex: f<sub>0</sub> =429.45 MHz  
 Series Capacitance =4 pF  
 Parallel Inductance =18 nH

External dimension

(Unit:mm)

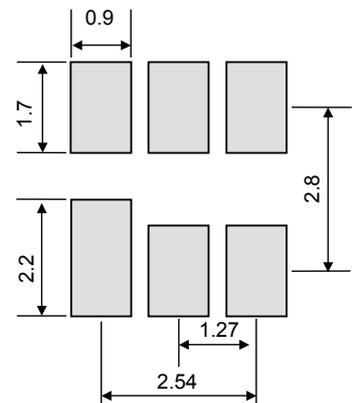
Footprint (Recommended)

(Unit:mm)



Pin map

Pin	Connection
1,3,4,6	GND
2,5	IN,OUT



## SAW FILTER FOR ISM BAND / RF

# TQS-566AA-7R TQS-557AA-7R TQS-542AA-7R

•Lead(Pb)-free : Lead free completely



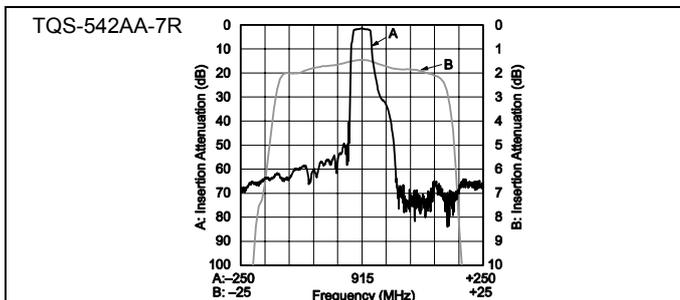
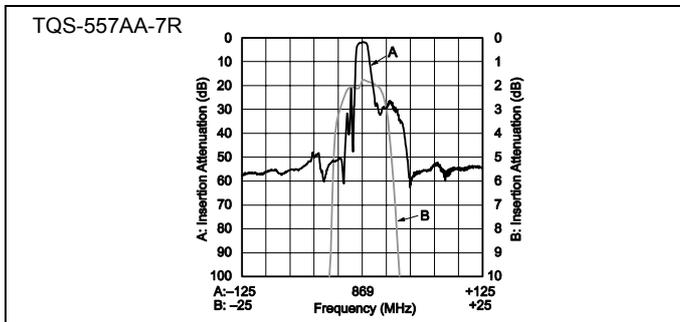
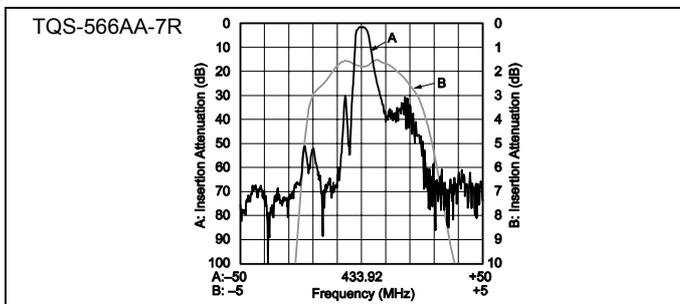
Actual size

TQS-566AA-7R	TQS-557AA-7R	TQS-542AA-7R

### Specifications (characteristics)

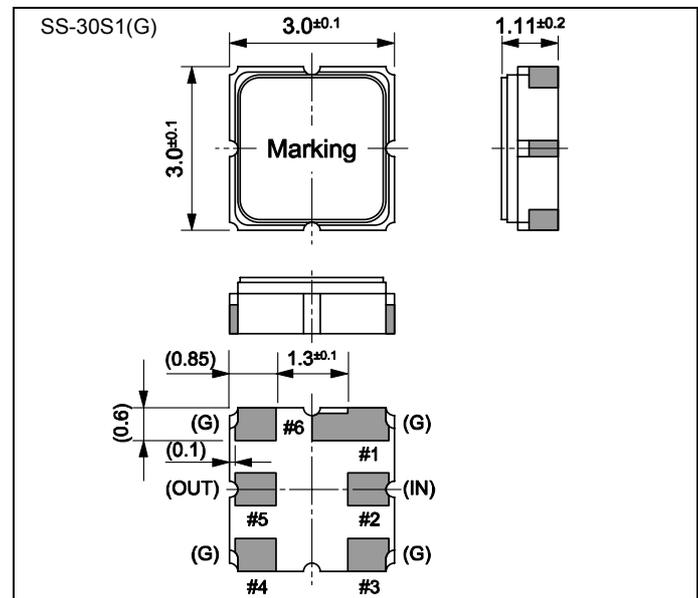
Item	Symbol	TQS-566AA-7R	TQS-557AA-7R	TQS-542AA-7R
Nominal frequency	$f_0$	433.92 MHz	869 MHz	915 MHz
Storage temperature range	$T_{stg}$	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C
Operating temperature range	$T_{use}$	-30 °C to +85 °C	-10 °C to +60 °C	-30 °C to +85 °C
Passband	BW	433.05 to 434.79 MHz	868 to 870 MHz	902 to 928 MHz
Insertion loss	IL	3.4 dB Max. (IL in passband)	3 dB Max. (IL in passband)	3.0 dB Max. (IL in passband)
Ripple	Ri	2 dBp-p Max.	1.5 dBp-p Max.	1.8 dBp-p Max.
VSWR	—	2.0 Max.	2.5 Max.	2.5 Max.
Stop band attenuation (relative to through level)	—	DC to 392 MHz : 55 dB Min. 392 to 414 MHz : 45 dB Min. 414 to 424.3 MHz : 40 dB Min. 443 to 475 MHz : 25 dB Min. 475 to 479 MHz : 55 dB Min. 479 to 1000 MHz : 40 dB Min.	DC to 828 MHz : 45 dB Min. 828 to 849 MHz : 30 dB Min. 880 to 890 MHz : 10 dB Min. 890 to 925 MHz : 22 dB Min. 925 to 1740 MHz : 40 dB Min.	DC to 843 MHz : 45 dB Min. 987 to 1857 MHz : 40 dB Min.
Terminating impedance	Z	50 $\Omega$ (Unbalanced)	50 $\Omega$ (Unbalanced)	50 $\Omega$ (Unbalanced)
Package	—	SS-30S1(G)	SS-30S1(G)	SS-30S1(G)

### Electrical DATA



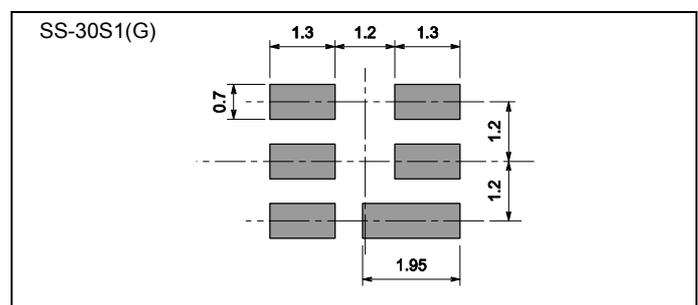
### External dimensions

(Unit : mm)



### Footprint (Recommended)

(Unit : mm)



## SAW FILTER FOR GPS / RF

### TQS-537AB-7G TQS-949AD-7G TQS-954EA-7R

- Low insertion loss type, High attenuation type and balanced termination type are available.
- FCB technology achieves miniature size and low profile.
- Lead(Pb)-free : Lead free completely



Actual size

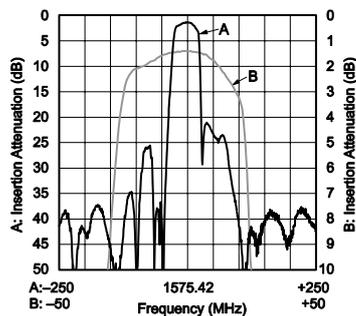
TQS-537AB-7G	TQS-949AD-7G	TQS-954EA-7R
■	■	■

### Specifications (characteristics)

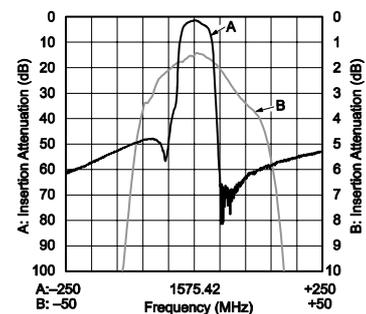
Item	Symbol	TQS-537AB-7G	TQS-949AD-7G	TQS-954EA-7R
Nominal frequency	$f_0$	1575.42 MHz	1575.42 MHz	1575.42 MHz
Storage temperature range	T_stg	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C
Operating temperature range	T_use	-30 °C to +85 °C	-40 °C to +85 °C	-30 °C to +85 °C
Passband	BW	1574.42 to 1576.42 MHz	1574.22 to 1576.62 MHz	1573.42 to 1577.42 MHz
Insertion loss	IL	1.8 dB Max. (IL in passband)	2.3dB Max. (IL in passband)	1.6 dB Max. (IL in passband)
Ripple	Ri	0.3 dBp-p Max.	0.6 dBp-p Max.	0.5 dBp-p Max.
VSWR	—	2.0 Max.	2.0 Max.	2.0 Max.
Stop band attenuation (relative to through level)	—	DC to 849 MHz : 35 dB Min. 849 to 1475 MHz : 32 dB Min. 1475 to 1525 MHz : 23 dB Min. 1625 to 1675 MHz : 20 dB Min. 1675 to 1750 MHz : 32 dB Min. 1750 to 1980 MHz : 35 dB Min. 1980 to 3155 MHz : 30 dB Min. 3155 to 6000 MHz : 28 dB Min.	824 to 960 MHz : 45 dB Min. 1475.42 MHz : 40 dB Min. 1525.42 MHz : 35 dB Min. 1625.42 MHz : 35 dB Min. 1675.42 MHz : 50 dB Min. 1710 to 1880 MHz : 45 dB Min. 1850 to 1990 MHz : 40 dB Min. 1920 to 2170 MHz : 40 dB Min.	824 to 894 MHz : 34 dB Min. 832 to 925 MHz : 34 dB Min. 1208.22 MHz : 36 dB Min. 1355.42 MHz : 40 dB Min. 1391.82 MHz : 43 dB Min. 1465.42 MHz : 36 dB Min. 1429 to 1501 MHz : 34 dB Min. 1501 to 1525 MHz : 23 dB Min. 1626.5 to 1660.5 MHz : 10 dB Min. 1750 to 1870 MHz : 41 dB Min. 1850 to 1990 MHz : 38 dB Min. 1920 to 170 MHz : 34 dB Min. 2400 to 2500 MHz : 30 dB Min.
Terminating impedance	Z	Input : 50 $\Omega$ (Unbalanced) Output : 100 $\Omega$ (Balanced)	50 $\Omega$ (Unbalanced)	50 $\Omega$ (Unbalanced)
Package	—	SS-2520(P)	SS-2520(E)	SS-2520(M)

### Electrical DATA

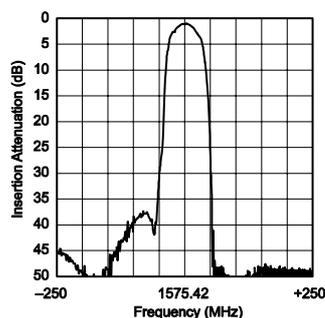
TQS-537AB-7G



TQS-949AD-7G



TQS-954EA-7R

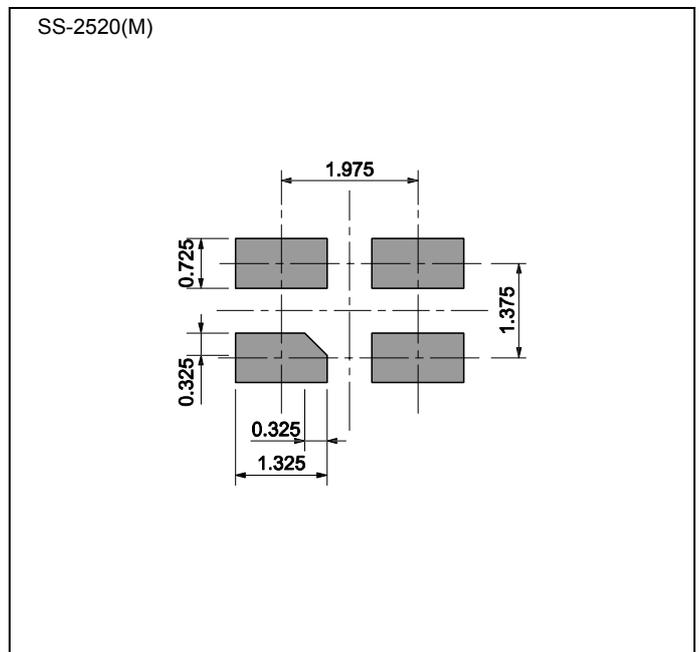
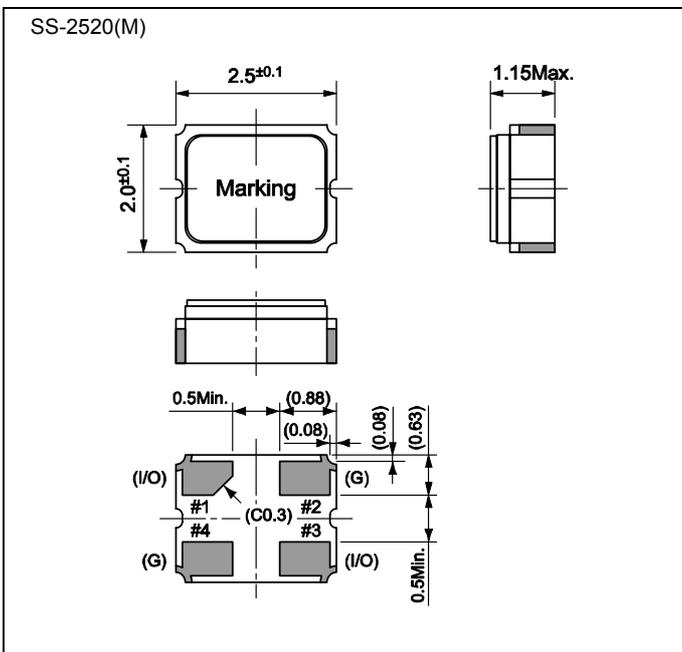
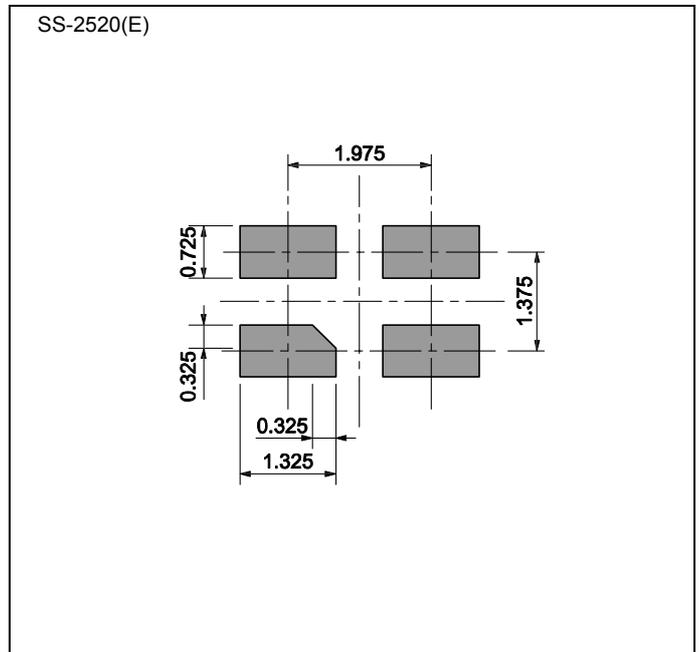
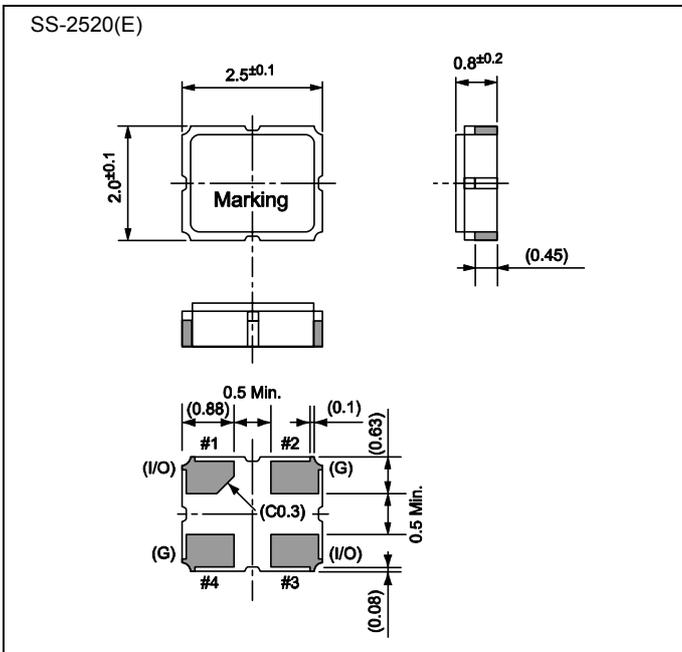
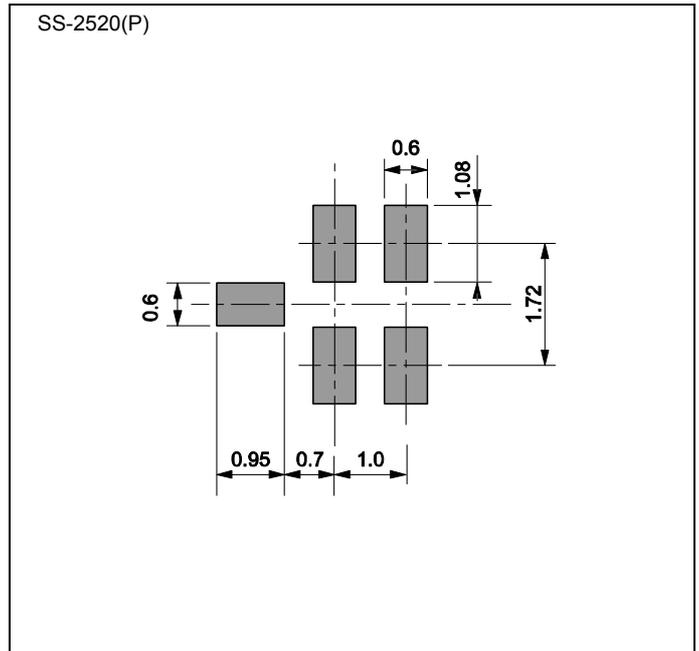
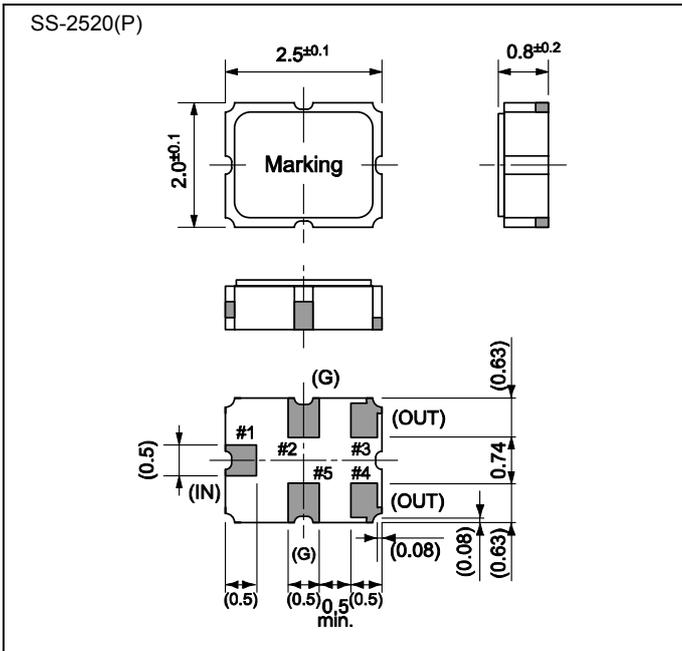


External dimensions

(Unit : mm)

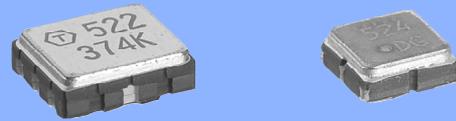
Footprint (Recommended)

(Unit : mm)



SAW FILTER  
FOR W-LAN / IFTQS-457A-7R  
TQS-471BB-7R

- Excellent performance in small size with original design algorithm.
- Lead(Pb)-free : Lead free completely



Actual size

TQS-457A-7R

TQS-471BB-7R



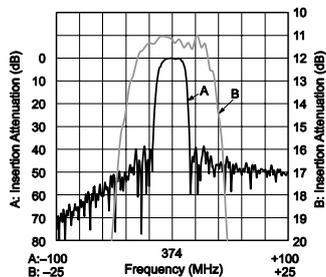
## Specifications (characteristics)

Item	Symbol	TQS-457A-7R	TQS-471BB-7R
Nominal frequency	$f_0$	374 MHz	374 MHz
Storage temperature range	$T_{stg}$	-40 °C to +85 °C	-40 °C to +85 °C
Operating temperature range	$T_{use}$	-40 °C to +85 °C	-30 °C to +70 °C
Passband	BW	$f_0 \pm 8.5$ MHz Min. (3 dB relative to IL at $f_0$ )	$f_0 \pm 8.5$ MHz Min. (3 dB relative to IL at $f_0$ )
Insertion loss	IL	12 dB Max. (at $f_0$ )	9 dB Max. (-30 °C to +30 °C) * (at $f_0$ ) 10 dB Max. (-30 °C to +70 °C) * (at $f_0$ )
Deviation in PB	DEV	—	1.5 dB Max.
Ripple	Ri	1.5 dB Max.	1.5 dB Max.
Group delay distortion	GDD	100 ns Max.	100 ns Max.
Stop band attenuation	—	$f_0 \pm (16.5 \text{ to } 22)$ MHz : 30 dB Min. $f_0 \pm (22 \text{ to } 33)$ MHz : 33 dB Min. $f_0 \pm (33 \text{ to } 100)$ MHz : 38 dB Min.	$f_0 - 41.5$ MHz to $f_0 - 22$ MHz : 40 dB Min. $f_0 - 22$ MHz to $f_0 - 18$ MHz : 35 dB Min. $f_0 - 18$ MHz to $f_0 - 16.5$ MHz : 35 dB Min. $f_0 + 16.5$ MHz to $f_0 + 18$ MHz : 35 dB Min. $f_0 + 18$ MHz to $f_0 + 22$ MHz : 35 dB Min. $f_0 + 22$ MHz to $f_0 + 41.5$ MHz : 35 dB Min.
Terminating impedance	Z	Input : 160 $\Omega$ // -8 pF (Balanced or Unbalanced) Output : 50 $\Omega$ // -15 pF (Balanced or Unbalanced)	Input : 680 $\Omega$ // 88 nH (Balanced or Unbalanced) Output : 780 $\Omega$ // 120 nH (Balanced or Unbalanced)
Package	—	SS-541(L)	SS-30S1(D)

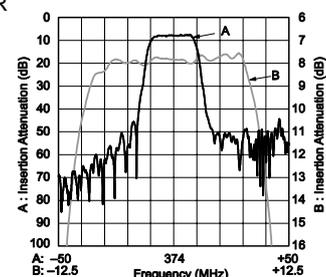
\* Includes losses in matching circuit (Matching inductor size : 1.6 × 0.8 mm)

## Electrical DATA

TQS-457A-7R



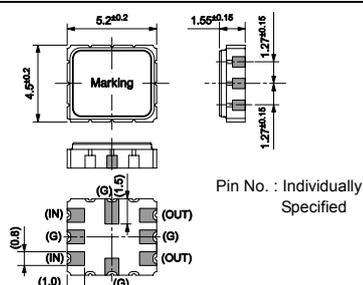
TQS-471BB-7R



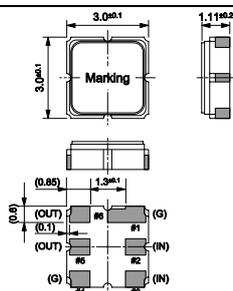
## External dimensions

(Unit : mm)

SS-541(L)



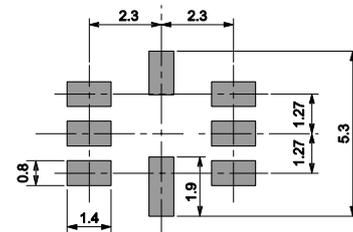
SS-30S1(D)



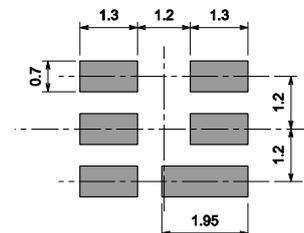
## Footprint (Recommended)

(Unit : mm)

SS-541(L)



SS-30S1(D)



# SAW FILTER FOR CORDLESS TELEPHONE / RF

## TQS-879A-7R

- TX filter and RX filter are built in 1 package.
- Lead(Pb)-free : Lead free completely



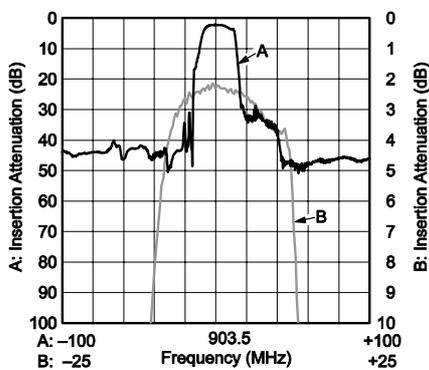
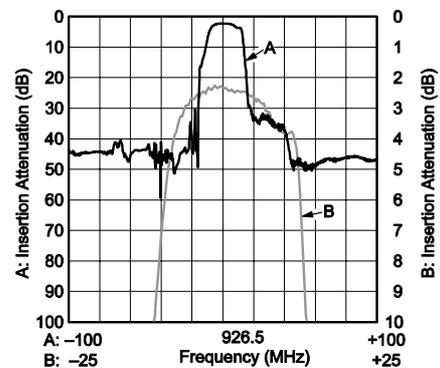
Actual size



### Specifications (characteristics)

Item	Symbol	TQS-879A-7R	
Nominal frequency	$f_0$	903.5 MHz( $f_0$ 1)	926.5 MHz( $f_0$ 2)
Storage temperature range	T_stg	-40 °C to +85 °C	
Operating temperature range	T_use	-10 °C to +50 °C	
Passband	BW	902.5 to 904.5 MHz	925.5 to 927.5MHz
Insertion loss	IL	3.5 dB Max. (IL in passband)	3.5dB Max. (IL in passband)
Stop band attenuation (relative to through level)	—	DC to 823.5 MHz : 40 dB Min. 823.5 to 863.5 MHz : 35 dB Min. 925.5 to 943.5 MHz : 25 dB Min. 943.5 to 963.5 MHz : 30 dB Min. 963.5 to 1003.5 MHz: 40 dB Min. 1003.5 to 3000 MHz : 20 dB Min.	DC to 846.5 MHz : 40 dB Min. 846.5 to 886.5 MHz : 35 dB Min. 886.5 to 904.5 MHz : 25 dB Min. 966.5 to 986.5 MHz : 30 dB Min. 986.5 to 1026.5 MHz: 40 dB Min. 1026.5 to 3000 MHz : 20 dB Min.
Terminating impedance	Z	50 $\Omega$ (Unbalanced)	
Package	—	SS-38S1(B)	

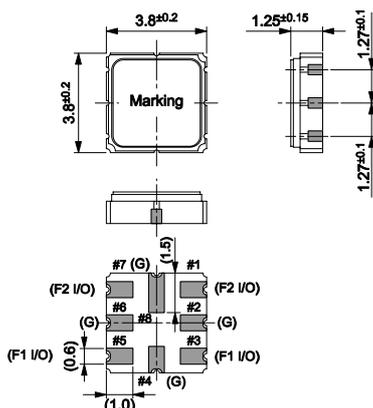
### Electrical DATA

TQS-879A-7R( $f_0$  1)TQS-879A-7R( $f_0$  2)

### External dimensions

(Unit :mm)

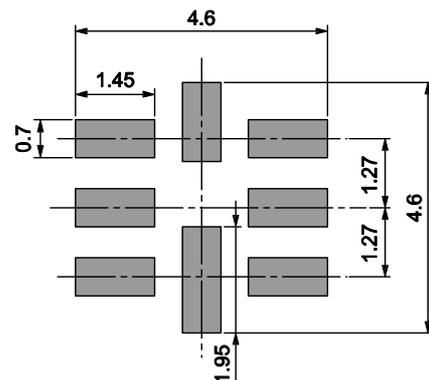
SS-38S1(B)



### Footprint (Recommended)

(Unit :mm)

SS-38S1(B)



## SAW FILTER FOR CELLULAR / RF

### TQS-530S-7G /-516EA-7G TQS-535AB-7G /-539A-7G

- Miniature size and low profile using FCB technology
- Balanced termination type and unbalanced termination type are available.
- Lead(Pb)-free : Lead free completely



Actual size

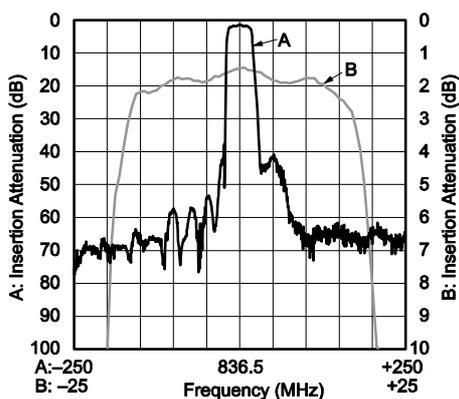
TQS-530S-7G	TQS-516EA-7G	TQS-535AB-7G	TQS-539A-7G

#### Specifications (characteristics)

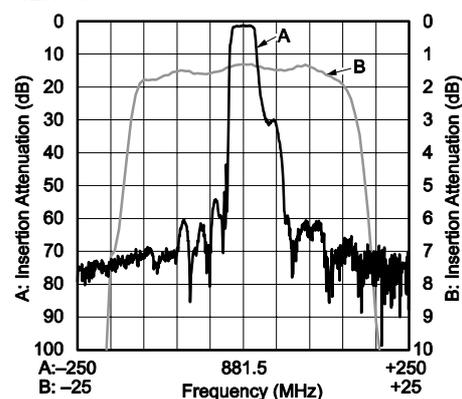
Item	Symbol	TQS-530S-7G	TQS-516EA-7G	TQS-535AB-7G	TQS-539A-7G
Nominal frequency	fo	836.5 MHz	881.5 MHz	881.5 MHz	906 MHz
Storage temperature range	T_stg	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C
Operating temperature range	T_use	-30 °C to +85 °C	-30 °C to +85 °C	-30 °C to +85 °C	-20 °C to +75 °C
Passband	BW	824 to 849 MHz	869 to 894 MHz	869 to 894 MHz	887 to 925 MHz
Insertion loss	IL	2.8 dB Max. (IL in passband)	2.4 dB Max. (IL in passband)	2.7 dB Max. (IL in passband)	3.5dB Max. (IL in passband)
Ripple	Ri	1.6 dBp-p Max.	1.2 dBp-p Max.	1.3 dBp-p Max.	2.0 dBp-p Max.
VSWR	—	2.0 Max.	2.0 Max.	2.0 Max.	3.2 Max.
Stop band attenuation (relative to through level)	—	DC to 800 MHz : 45 dB Min. 869 to 910 MHz : 38 dB Min. 910 to 2000 MHz : 45 dB Min. 2000 to 3000 MHz: 20 dB Min.	DC to 849 MHz : 45 dB Min. 914 to 954 MHz : 24 dB Min. 954 to 1200 MHz : 50 dB Min. 1200 to 2000 MHz: 40 dB Min. 2000 to 3000 MHz: 20 dB Min.	DC to 824 MHz : 47 dB Min. 824 to 849 MHz : 47 dB Min. 915 to 1000 MHz : 32 dB Min. 1000 to 1738 MHz: 42 dB Min. 1738 to 1788 MHz: 42 dB Min. 1788 to 3000 MHz: 37 dB Min.	DC to 761 MHz : 50 dB Min. 761 to 870 MHz : 38 dB Min. 1051 to 1092 MHz: 50 dB Min. 1092 to 3000 MHz: 23 dB Min.
Terminating impedance	Z	50 Ω (Unbalanced)	50 Ω (Unbalanced)	Input : 50 Ω (Unbalanced) Output : 100 Ω (Balanced)	50 Ω (Unbalanced)
Package	—	SS-2520(E)	SS-2520(E)	SS-2520(P)	SS-2520(E)

#### Electrical DATA

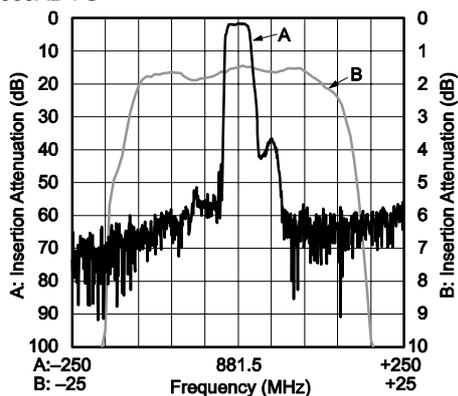
●TQS-530S-7G



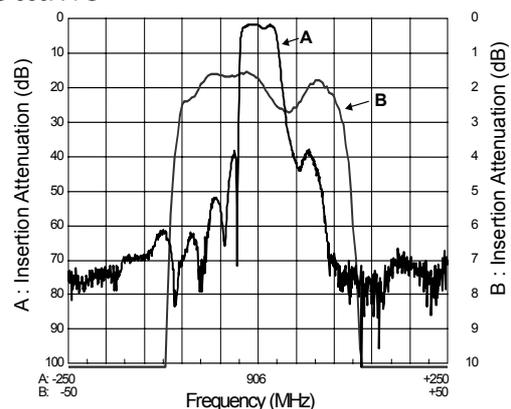
●TQS-516EA-7G



●TQS-535AB-7G

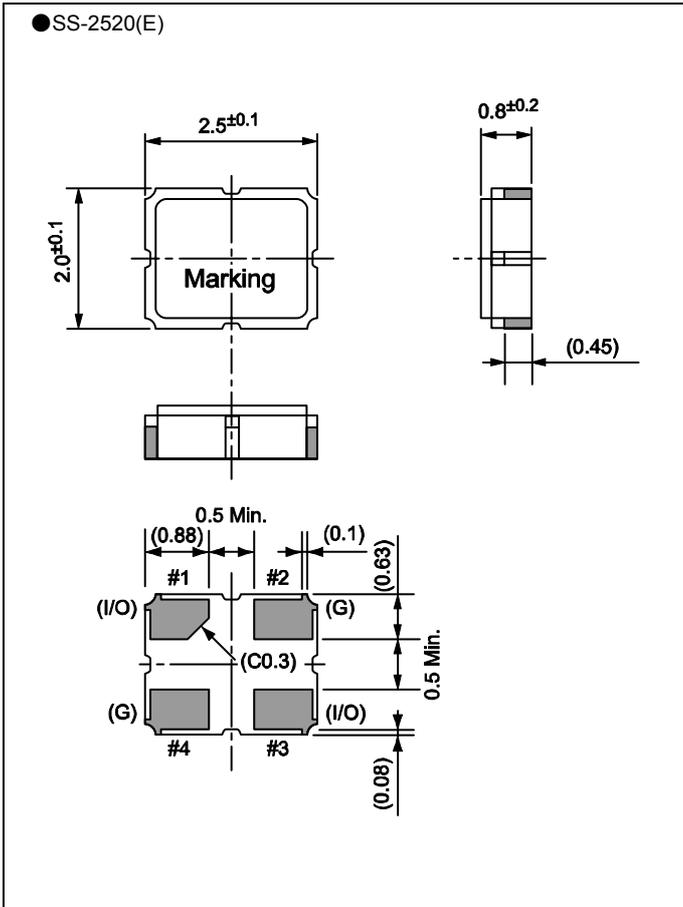


●TQS-539A-7G



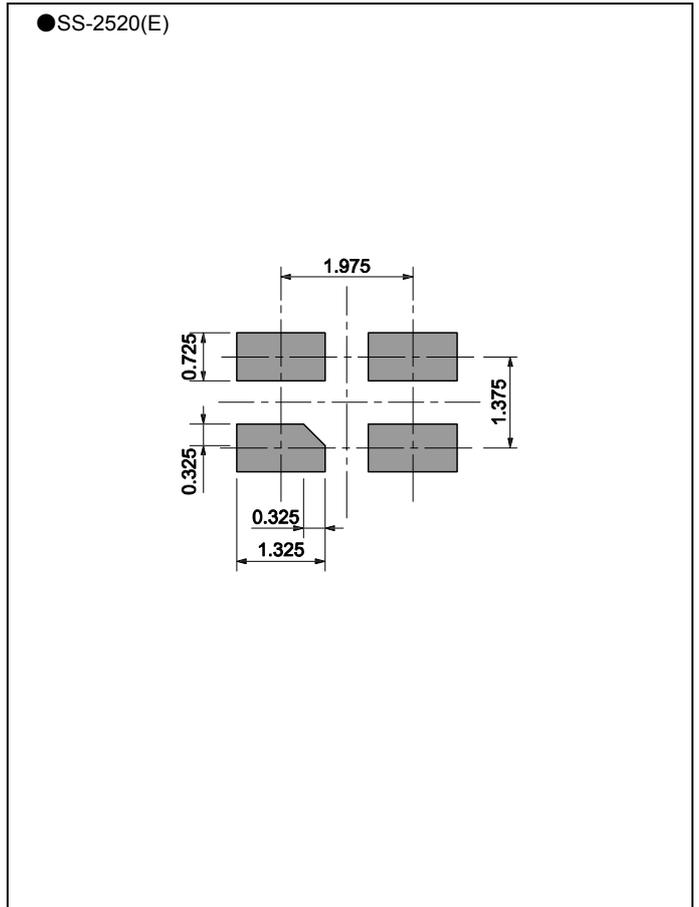
External dimensions

(Unit :mm)

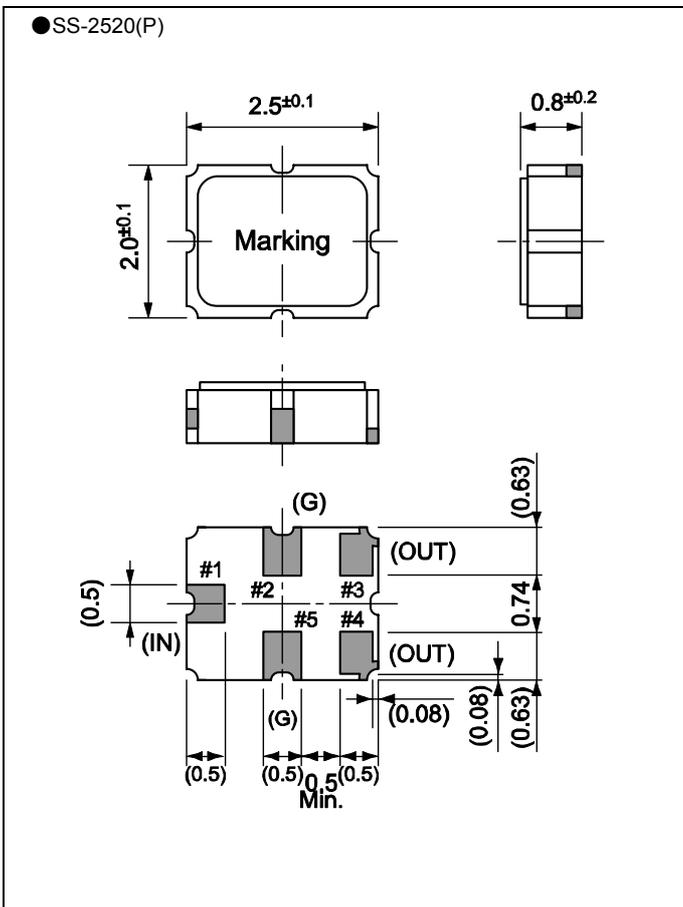


Footprint (Recommended)

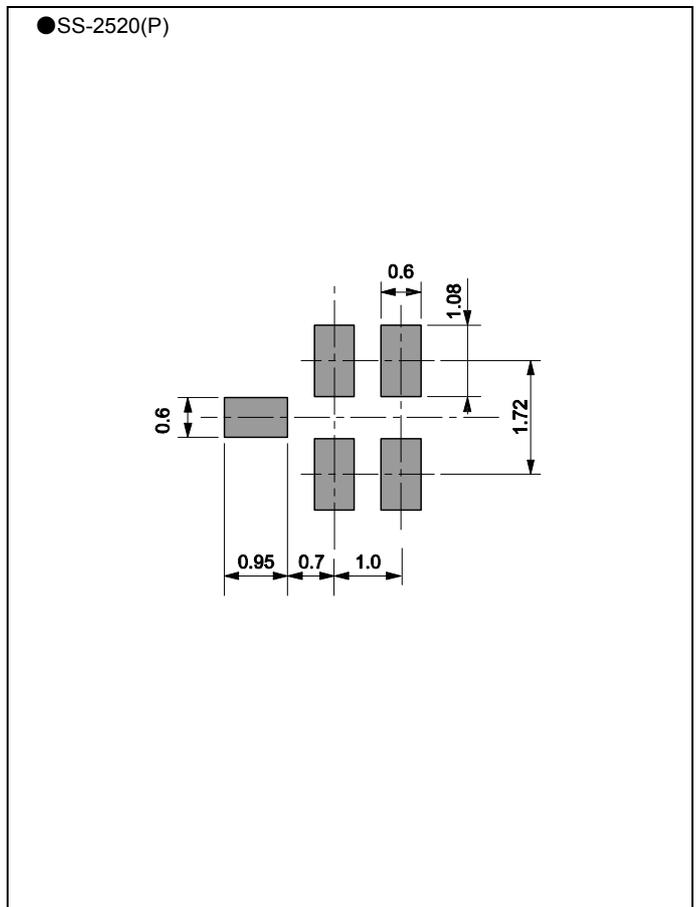
(Unit :mm)



●SS-2520(P)



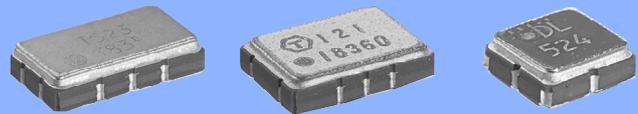
●SS-2520(P)



## SAW FILTER FOR CELLULAR / IF

### TQS-465AA-7R TQS-663AA-7R TQS-477AA-7R

- Excellent performance in small size with original design algorithm.
- Lead(Pb)-free : Lead free completely



Actual size



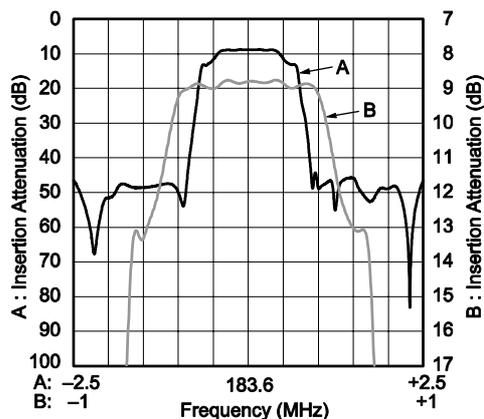
### Specifications (characteristics)

Item	Symbol	TQS-465AA-7R	TQS-663AA-7R	TQS-477AA-7R
Nominal frequency	$f_0$	183.6 MHz	183.6 MHz	190 MHz
Storage temperature range	$T_{stg}$	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C
Operating temperature range	$T_{use}$	-30 °C to +85 °C	-30 °C to +85 °C	-30 °C to +85 °C
Passband	BW	$f_0 \pm 615$ kHz Min. (5 dB relative to IL at $f_0$ )	$f_0 \pm 11$ kHz Min. (5 dB relative to minimum IL)	$f_0 \pm 2.3$ MHz Min. (3 dB relative to IL at $f_0$ )
Insertion loss	IL	11 dB Max. (at $f_0$ )*	5 dB Max. (minimum IL)	7 dB Max. (at $f_0$ )
Deviation in PB	DEV	1.2 dB Max.	—	—
Ripple	Ri	1.2 dB Max.	2 dB Max.	2 dB Max. ( $f_0 - 2$ MHz to $f_0 + 2$ MHz)
Group delay distortion	GDD	—	10 $\mu$ s Max.	100 ns Max. ( $f_0 - 2$ MHz to $f_0 + 2$ MHz)
Phase linearity	PHL	3.2 deg rms Max.	—	—
Stop band attenuation	—	$f_0 \pm 0.9$ MHz : 33 dB Min. $f_0 \pm 1.25$ MHz : 33 dB Min. $f_0 \pm 1.7$ MHz : 33 dB Min. $f_0 \pm 2.05$ MHz : 33 dB Min. 10 MHz to $f_0 - 9$ MHz : 40 dB Min. $f_0 + 9$ MHz to $f_0 + 15$ MHz : 35 dB Min. $f_0 + 15$ MHz to $f_0 + 100$ MHz : 45 dB Min. (relative to IL at $f_0$ )	$f_0 \pm 60$ kHz : 8 dB Min. $f_0 \pm 120$ kHz : 35 dB Min. $f_0 \pm 1$ MHz : 60 dB Min.  (relative to minimum IL)	$f_0 - 100$ MHz to $f_0 - 12.5$ MHz : 40 dB Min. $f_0 - 12.5$ MHz to $f_0 - 7.5$ MHz : 25 dB Min. $f_0 - 7.5$ MHz to $f_0 - 5$ MHz : 10 dB Min. $f_0 + 5$ MHz to $f_0 + 7.5$ MHz : 10 dB Min. $f_0 + 7.5$ MHz to $f_0 + 12.5$ MHz : 25 dB Min. $f_0 + 12.5$ MHz to $f_0 + 100$ MHz : 40 dB Min. (relative to IL at $f_0$ )
Terminating impedance	Z	Input : 1020 $\Omega$ // -2.5 pF (Balanced or Unbalanced) Output : 810 $\Omega$ // -4.4 pF (Balanced or Unbalanced)	Input : 450 $\Omega$ // -0.04 pF (Unbalanced) Output : 450 $\Omega$ // -0.04 pF (Unbalanced)	Input : 1000 $\Omega$ // -5.0 pF (Balanced or Unbalanced) Output : 1000 $\Omega$ // -4.0 pF (Balanced or Unbalanced)
Package	—	SS-631(A)	SS-752(E)	SS-30S1(DE)

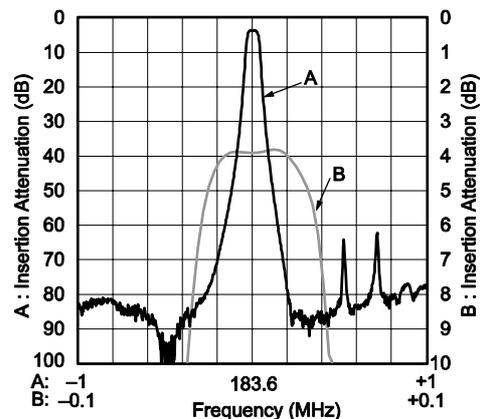
\* Includes losses in matching circuit (Matching inductor size : 1.6 × 0.8 mm)

### Electrical DATA

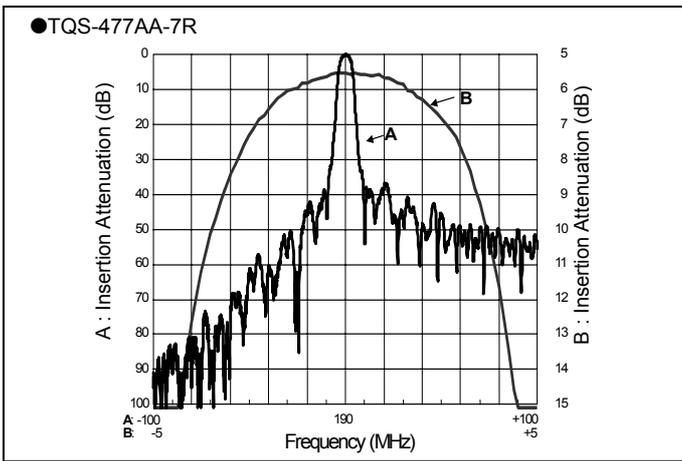
#### ●TQS-465AA-7R



#### ●TQS-663AA-7R

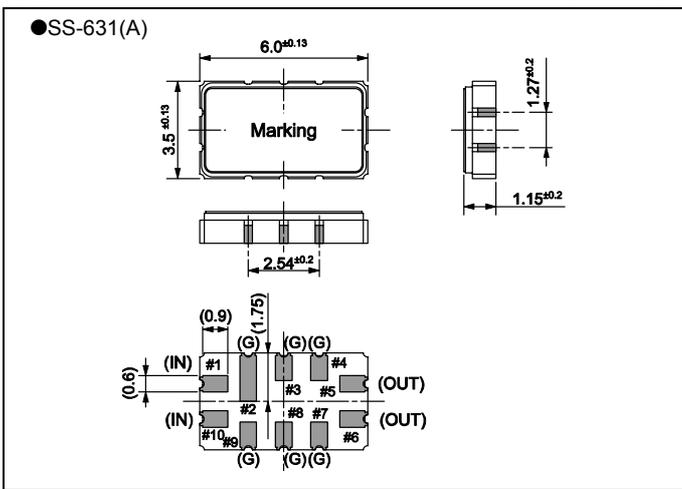


Electrical DATA



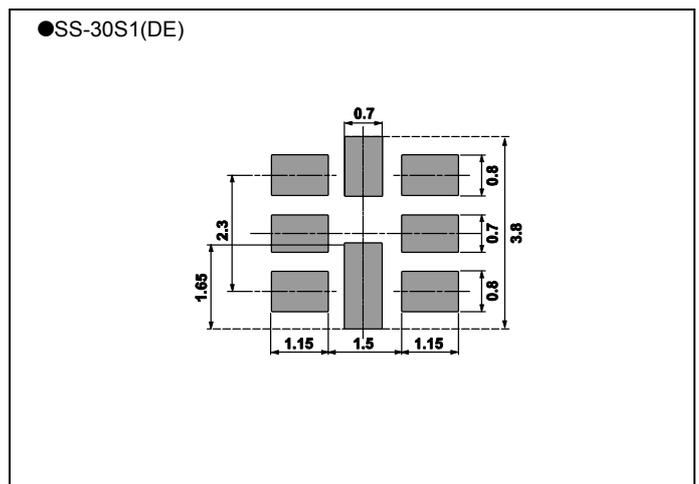
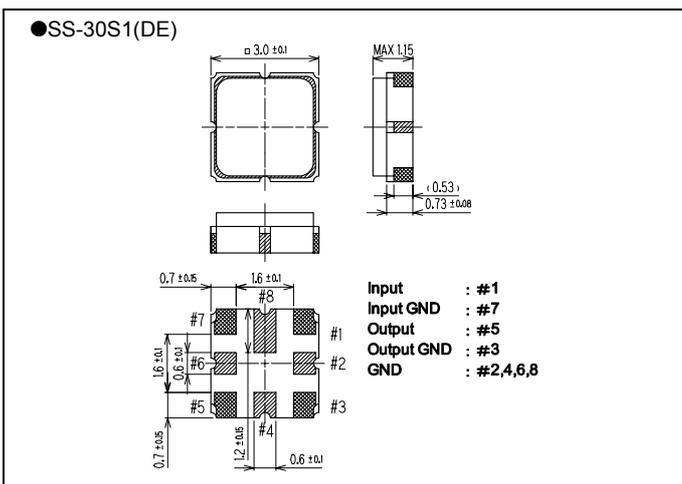
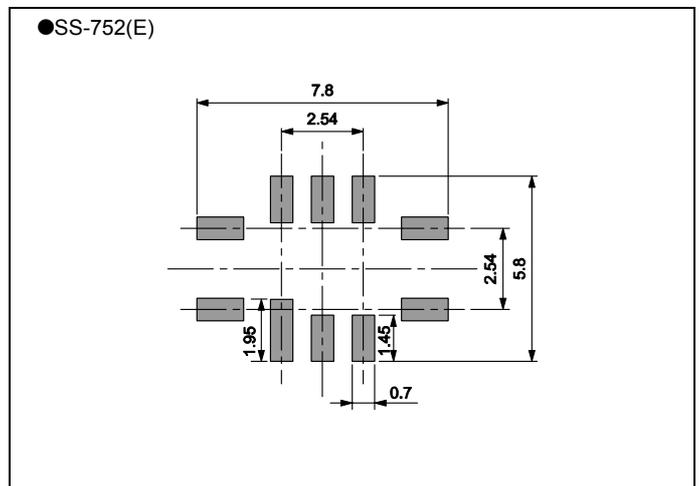
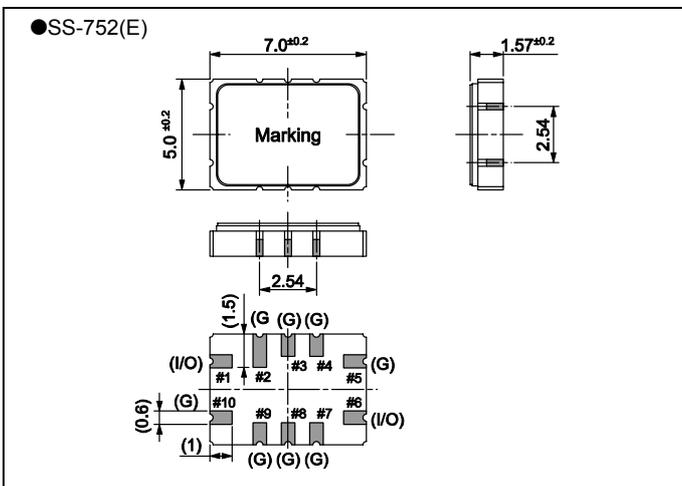
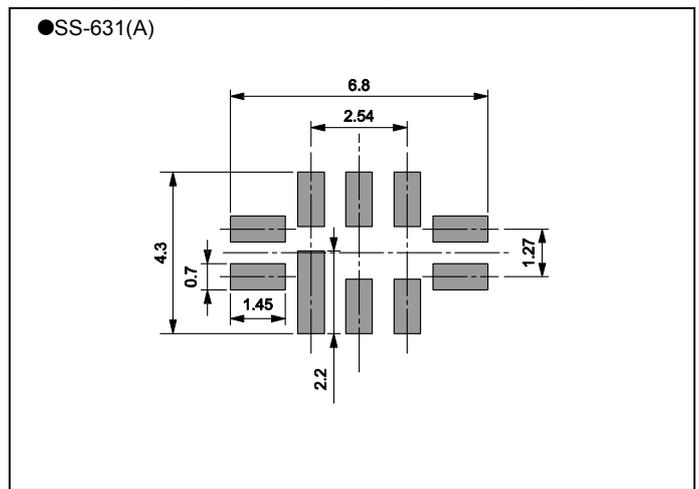
External dimensions

(Unit :mm)



Footprint (Recommended)

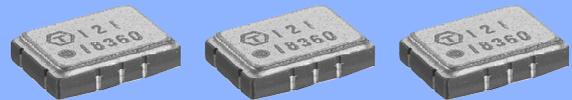
(Unit :mm)



**SAW FILTER  
FOR CELLULAR BASE STATION / IF**

**TQS-474AA-7R  
TQS-472BA-7R**

- Excellent performance in small size with original design algorithm
- Lead(Pb)-free : Lead free completely



Actual size

TQS-474AA-7R

TQS-472BA-7R

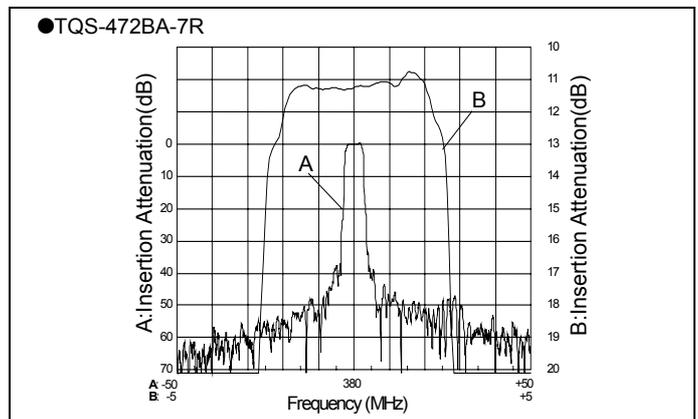
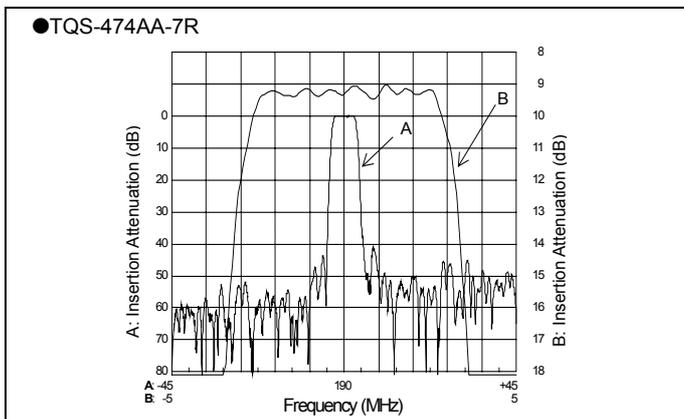


**Specifications (characteristics)**

Item	Symbol	TQS-474AA-7R	TQS-472BA-7R
Nominal frequency	$f_0$	190 MHz	380 MHz
Storage temperature range	$T_{stg}$	-40 °C to +85 °C	-40 °C to +85 °C
Operating temperature range	$T_{use}$	-30 °C to +85 °C	-30 °C to +85 °C
Passband	BW	$f_0 \pm 2.6$ MHz Min. (3 dB relative to IL at $f_0$ )	$f_0 \pm 2.2$ MHz Min. (3 dB relative to IL at $f_0$ )
Insertion loss	IL	11.5 dB Max. *	12.5 dB Max. *
Ripple	Ri	1.0 dB Max. ( $f_0 \pm 2.1$ MHz)	1.2 dB Max. ( $f_0 \pm 1.92$ MHz)
Group delay distortion	GDD	100 ns Max. ( $f_0 \pm 2.1$ MHz)	180 ns Max. ( $f_0 \pm 1.92$ MHz)
Phase linearity	PHL	—	4 deg rms Max. ( $f_0 \pm 1.92$ MHz)
Stop band attenuation (relative to IL at $f_0$ )	—	10 dBBW: $f_0 \pm 4.1$ MHz Max. $f_0 - 45$ MHz to $f_0 - 10$ MHz : 45 dB Min. $f_0 - 10$ MHz to $f_0 - 5$ MHz : 40 dB Min. $f_0 + 5$ MHz to $f_0 + 12$ MHz : 36 dB Min. $f_0 + 12$ MHz to $f_0 + 23$ MHz: 45 dB Min. $f_0 + 23$ MHz to $f_0 + 45$ MHz: 40 dB Min.	10 dBBW: $f_0 \pm 3.25$ MHz Max. 20 dBBW: $f_0 \pm 3.65$ MHz Max. 30 dBBW: $f_0 \pm 4.00$ MHz Max. DC to $f_0 - 25$ MHz : 45 dB Min. $f_0 - 25$ MHz to $f_0 - 10$ MHz : 42 dB Min. $f_0 - 10$ MHz to $f_0 - 5.0$ MHz : 35 dB Min. $f_0 + 5.0$ MHz to $f_0 + 10$ MHz : 35 dB Min. $f_0 + 10$ MHz to $f_0 + 40$ MHz : 40 dB Min. $f_0 + 40$ MHz to $f_0 + 100$ MHz : 45 dB Min.
Terminating impedance	Z	Input : 610 $\Omega$ // -9.5 pF (Unbalanced) Output : 690 $\Omega$ // -9.0 pF (Unbalanced)	Input : 365 $\Omega$ // -8.0 pF (Unbalanced) Output : 525 $\Omega$ // -5.0 pF (Unbalanced)
Package	—	SS-752(H)	SS-752(H)

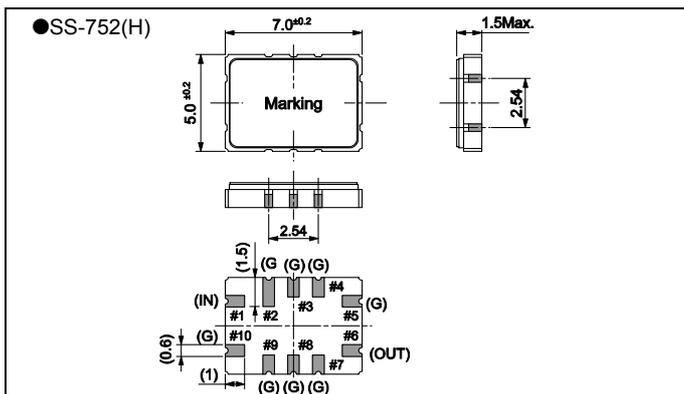
\* Includes losses in matching circuit (Matching inductor size : 1.6 × 0.8 mm)

**Electrical DATA**



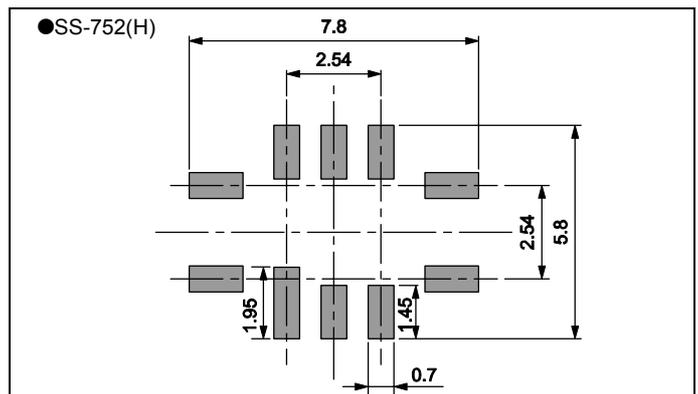
**External dimensions**

(Unit :mm)



**Footprint (Recommended)**

(Unit :mm)





## Sensing device

■ Gyro Sensor (Angular rate Sensor).....	148
<b>XV-3500 CB</b>	
■ Crystal Temperature Sensor.....	149
<b>HTS-206</b>	
■ Crystal Pressure Sensor.....	150
<b>TSU-10GL</b>	
<b>TSU-20G</b>	
<b>TSU-70G</b>	
<b>TSU-100G</b>	

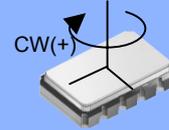


## Optical device

■ 1/4, 1/2 Wave Plate.....	151
C type (Single plate)	
D type (Double plates)	
G type (Double plates)	
■ Dichroic Prism.....	152
<b>MSK114</b>	
<b>MSK053C</b>	
■ Dichroic Mirror.....	153
<b>MSK387C</b>	
■ Dichroic Plate.....	153
<b>MSK861</b>	
■ Grating.....	154
■ Dichroic Filter.....	154
■ OLPF.....	155
<b>IR-cut Filter (MSK847)</b>	
<b>UV•IR-cut Filter (MSK763)</b>	
■ Heat Sink Plate.....	156
■ Etalon Filter.....	156

**SENSOR**  
**ULTRA MINIATURE SIZE VIBRATION GYRO SENSOR**  
 (angular rate sensor)  
**XV-3500CB**

- Ultra Small Package size SMD(5 × 3.2 × 1.3 mm)
- Hermetic sealing provides excellent sustainable environmental capability
- High stability using vibration crystal
- Clipped startup time and low power consumption with sleep mode
- Lead(Pb)-free : Lead free completely
- **Recommended Application**
- Detection picture stabilization of DVC and DSC
- Detection of moving with man machine interface



Actual size



**Specifications (characteristics)**

●Absolute Max. Rating

Item	Symbol	Specifications			Remarks
		Min.	Typ.	Max.	
Supply Voltage	V <sub>DD</sub>	-0.3 V		7.0 V	V <sub>SS</sub> =0 V
Input Voltage	V <sub>IN</sub>	-0.3 V		V <sub>DD</sub> +0.3 V	V <sub>SS</sub> =0 V
Storage Temperature	T <sub>STG</sub>	-40 °C		+85 °C	

●Operating Condition

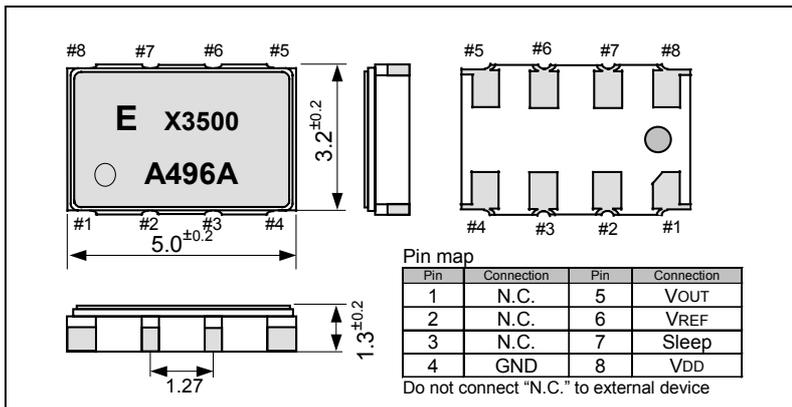
Item	Symbol	Specifications			Remarks
		Min.	Typ.	Max.	
Operating Voltage	V <sub>DD</sub>	2.7 V	3.0 V	3.3 V	V <sub>SS</sub> =0 V
Operating Temperature	T <sub>OPR</sub>	-20 °C		+80 °C	
Output Current	I <sub>VO</sub>	0		±100 μA	

●Electrical Characteristics

Item	Symbol	Specifications			Remarks
		Min.	Typ.	Max.	
Drive Frequency	f <sub>d</sub>		46.5 kHz 50.3 kHz		
Scale Factor	S <sub>o</sub>		0.67 mV/deg/s		
Limital Scale Factor accuracy	S <sub>p</sub>			±5 %	T <sub>a</sub> =+25 °C
Scale Factor temperature Sensitivity	S <sub>pt</sub>			±5 %	Based +25 °C, V <sub>DD</sub> =3.0 V
Bias	V <sub>o</sub>	V <sub>r</sub> -50 mV	V <sub>r</sub>	V <sub>r</sub> +50 mV	T <sub>a</sub> =+25 °C
Reference Voltage	V <sub>r</sub>	1320 mV	1350 mV	1380 mV	T <sub>a</sub> =+25 °C
Defection Range	I	-100 deg/s		+100 deg/s	
Non Linearity	NI			±5 % FS	T <sub>a</sub> =+25 °C
Phase Delay	φ <sub>20</sub>		4 (Degree)		at 20Hz phase delay angle
Frequency Response	BW		200 Hz		phase delay angle 90 °
Residual Noise	r <sub>N</sub>			20 mV p-p	Using EPSON circuit
Cross Axes Sensitivity	CS			±5 %	T <sub>a</sub> =+25 °C
Power Consumption	In Operating	I <sub>op</sub>	1.7 mA		V <sub>o</sub> , V <sub>r</sub> : Output No load condition
	Sleep Mode	I <sub>sleep</sub>	1 mA		V <sub>o</sub> , V <sub>r</sub> : Output No load condition
Startup Time	T <sub>sta</sub>		240 ms		T <sub>a</sub> =+25 °C, V <sub>DD</sub> =3.0 V

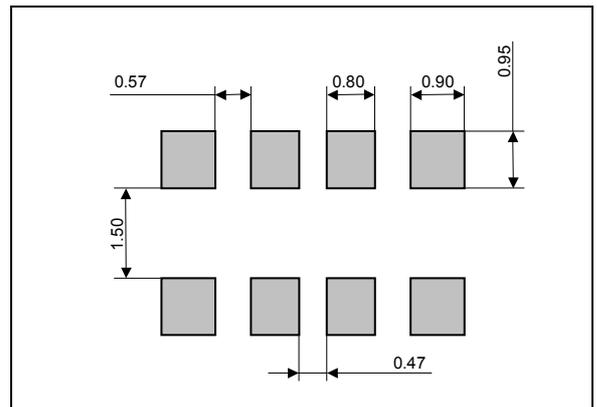
**External Dimensions**

(Unit:mm)



**Footprint (Recommended)**

(Unit:mm)



## SENSOR TEMPERATURE SENSING CRYSTAL

### HTS -206

- Crystal used to sense the change in temperature.
- 2 mm in diameter and 6 mm in length.
- Good linearity frequency and temperature.
- Low frequency (40 kHz) enables low current consumption.
- Wide temperature range (-40 °C to +85 °C).
- Suitable for DTCXO and temperature equipment.
- Lead(Pb)-free : Contains high melting temperature type solders.  
(Pb85 %)



Actual size

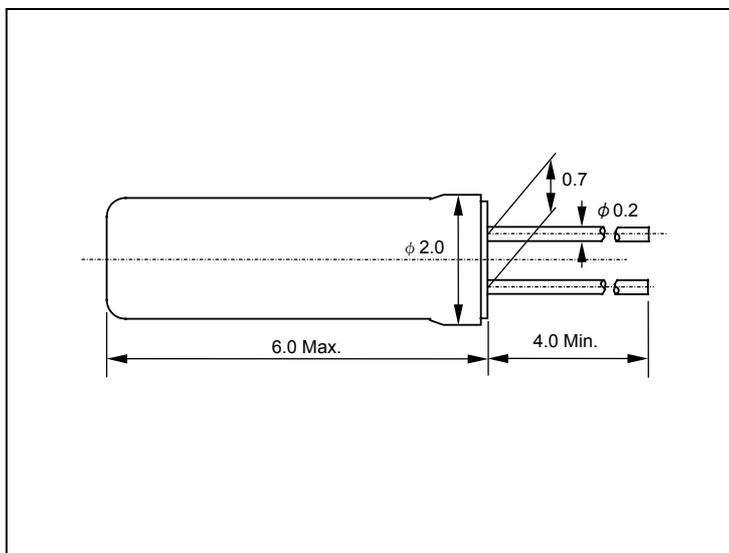


#### Specifications (characteristics)

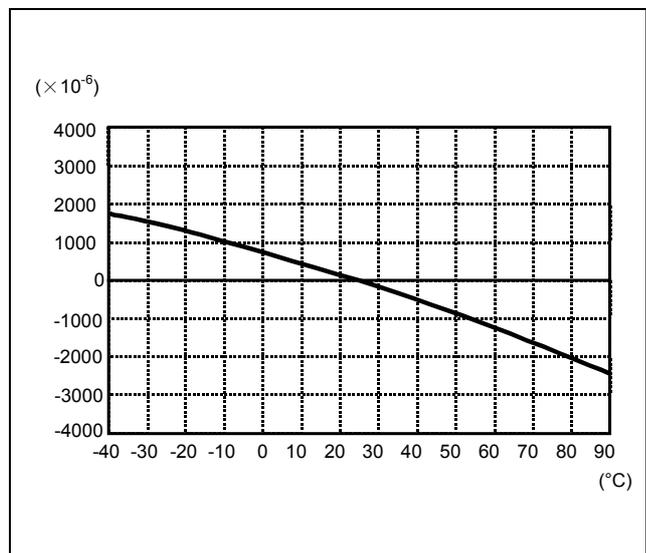
Item	Symbol	Specifications	Remarks	
Nominal frequency range	f <sub>0</sub>	40 kHz		
Temperature range	Storage temperature	T <sub>stg</sub>	-55 °C to +125 °C	Stored as bare product after unpacking
	Operating temperature	T <sub>use</sub>	-40 °C to +85 °C	
Level of drive	DL	0.1 μW Typ.		
Frequency tolerance	f <sub>tol</sub>	±2 %	+25 °C ,DL=0.1 μW	
1st. Temperature coefficient	α	-26.0 × 10 <sup>-6</sup> / °C ( ±2 %)		
2nd. Temperature coefficient	β	-5.8 × 10 <sup>-8</sup> / °C <sup>2</sup> ( ±8 %)		
3rd. Temperature coefficient	γ	-1.5 × 10 <sup>-10</sup> / °C <sup>3</sup> Max.		
Motional resistance(ESR)	R1	30 kΩ Max.	+25 °C,DL=0.1 μW	
Motion capacitance	C1	2.0 fF Typ.		
Shunt capacitance	C0	0.9 pF Typ.		
Insulation resistance		500 MΩ Min.		
Frequency aging	f <sub>age</sub>	± 3 × 10 <sup>-6</sup> / year Max.	+25 °C	

#### External dimensions

(Unit:mm)



#### Frequency Temperature coefficient



# SENSOR QUARTZ PRESSURE SENSOR

## TSU Series

- High resolution and accuracy
- Excellent repeatability with minimal hysteresis
- High stability against temperature variation
- Free from the error from cable length
- Lead(Pb)-free : Contains Pb in this product exempted by RoHS directive.

Applications : Various kinds of pressure measurement for industrial use

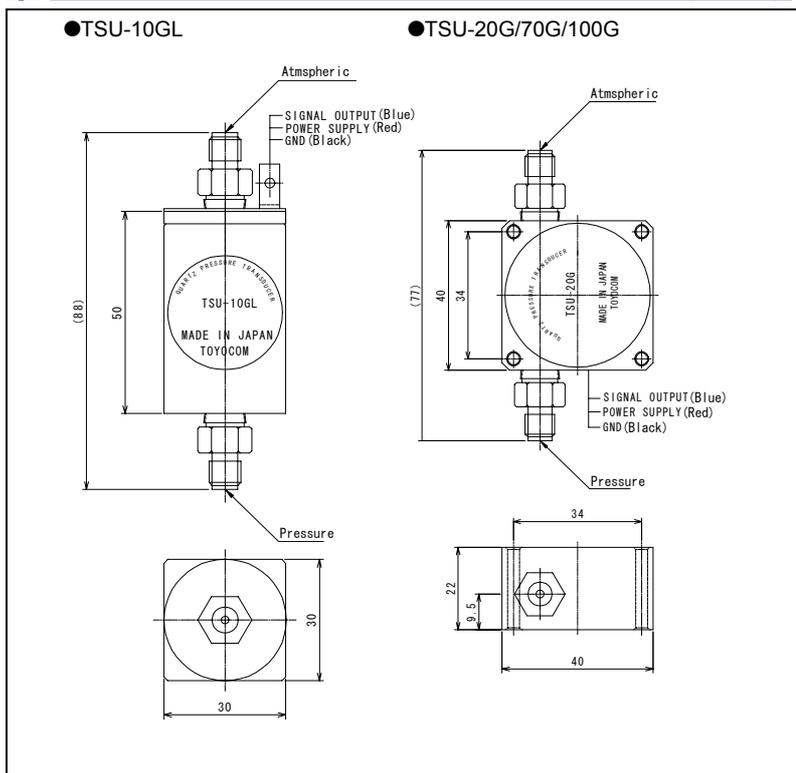


### Specifications (characteristics)

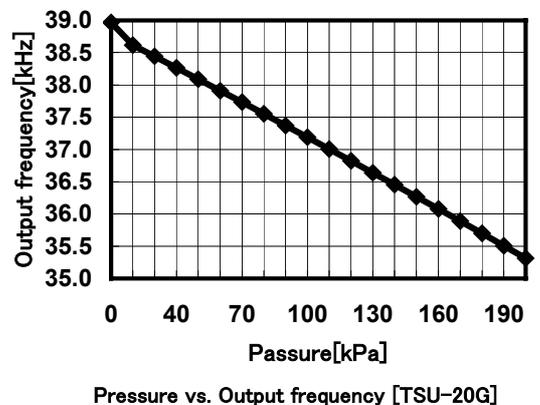
Item	Symbol	TSU-10GL	TSU-20G	TSU-70G	TSU-100G
Pressure measurement range	—	0 to 100 kPa	0 to 200 kPa	0 to 700 kPa	0 to 1 MPa
Linearity after linearization	—	0.1 %FS Max.	0.05 %FS Max.		
Repeatability	—	0.005 %FS Typ.			
Hysteresis	—	0.008 %FS Typ.			
Operating temperature range	T_use	-10 °C to +70 °C			
Storage temperature range	T_stg	-20 °C to +80 °C			
Operating humidity range	—	0 % to 95 %			
Tilt correction	—	None	Equipped		
Built-in temperature sensor	—	None	Option	Option	Option
Output frequency without pressure	—	39 kHz Typ.			
Maximum frequency change	—	4,000 Hz Typ.			
Output waveform	—	Rectangular wave			
Output voltage	V <sub>pp</sub>	3.2 V <sub>p-p</sub> Min. (output load 600 Ω)			
Supply voltage	V <sub>cc</sub>	12 V (Standard)			
Current consumption	I <sub>cc</sub>	2 mA Typ. (output load 600 Ω)			
Pressure input/output port	—	PT 1/8"			
Weight	—	200g			
Material	—	SUS304			

### External dimensions

(Unit:mm)



### Typical Data



OPTICAL DEVICE

# 1/4, 1/2 Wave Plate

- Wide selection of types according to application
- Excellent weather resistance

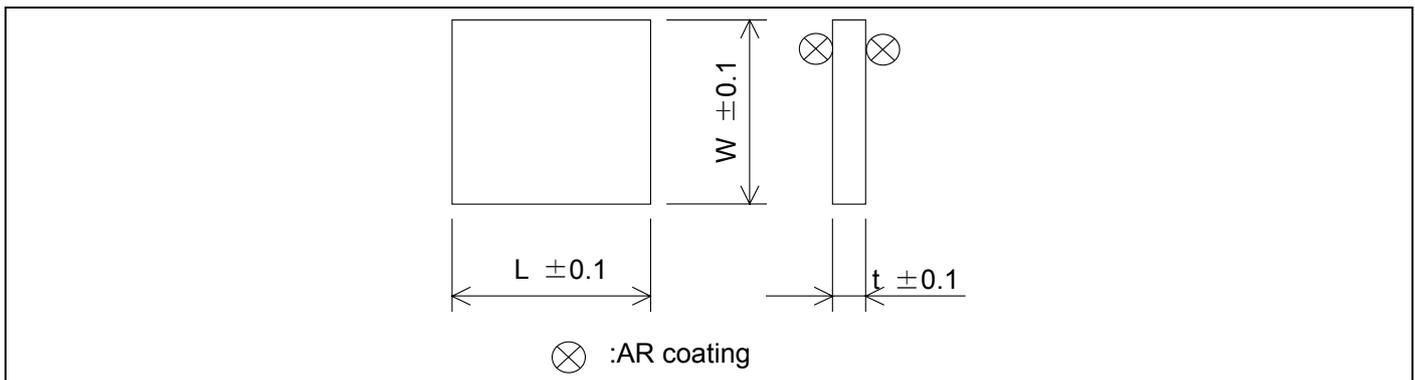


## Specifications

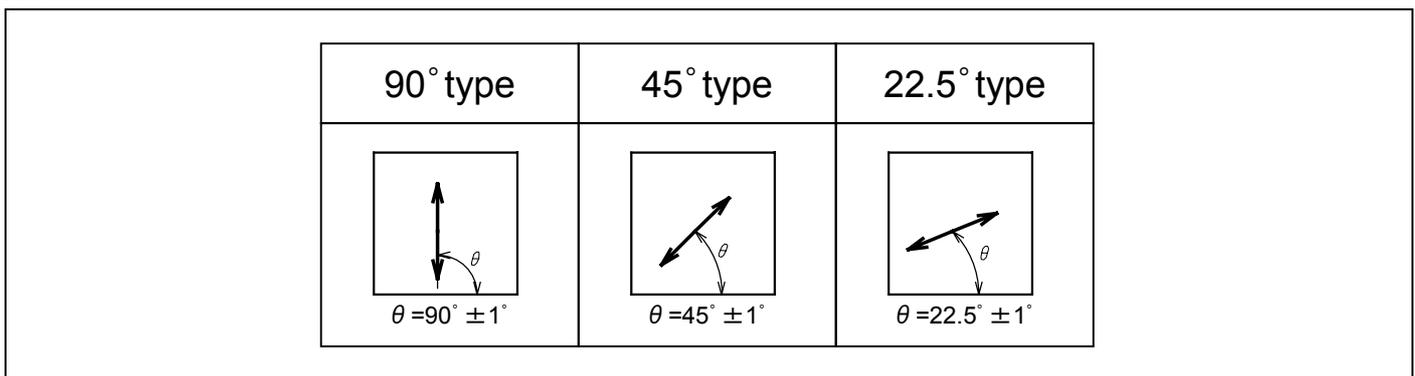
Type	1/4 Wave plate			1/2 Wave plate		
	C type (Single plate)	D type (Double plate)	G type (Double plate)	C type (Single plate)	D type (Double plate)	G type (Double plate)
Material	Synthetic quartz					
Wavelength	660 nm · 785 nm					
Incident Angle	0 °±0.5 °	0 °±5 °		0 °±0.5 °	0 °±5 °	
Dimensions L × W (mm)	Standard: 4.0 × 4.0 Other dimensions upon request					
Thickness t(mm)	0.4	1.1	0.4	0.8	1.1	0.8
Phase retardation	90 °±3 °		90 °±5 °	180 °±3 °		180 °±5 °
Reflectance of AR coating	0.5 % Max. (Insident angle:0 °)					
Wavefront aberration	0.020 λ rms (φ3 mm)	0.025 λ rms (φ3 mm)		0.020 λ rms (φ3 mm)	0.025 λ rms (φ3 mm)	
Wavelength dependency (660 nm)	-0.15 °/nm			-0.30 °/nm		
Incident angle dependency (660 nm)	6.1 °/°	1.8 °/°	0.6 °/°	18.5 °/°	1.8 °/°	1.5 °/°

## Outline Drawing

(Unit :mm)



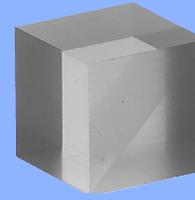
## Optical Axis Direction



OPTICAL DEVICE

# Dichroic Prism (MSK114, MSK053C)

•For dichroic use

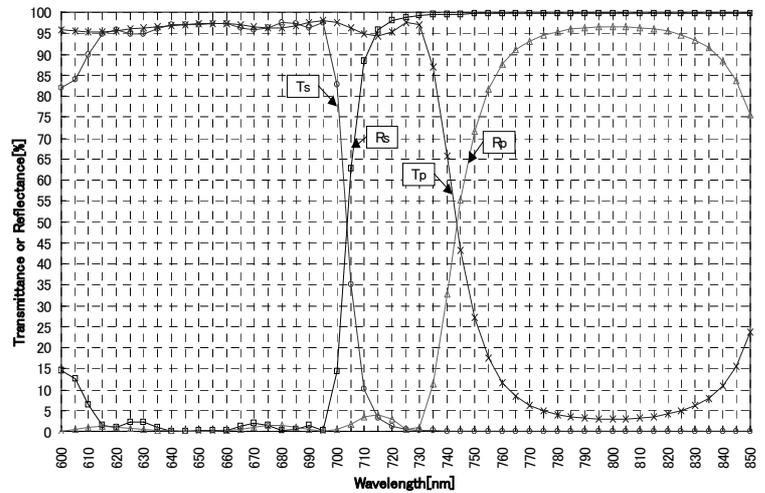


## MSK114

### Specifications

Material	BK7 or equivalent		
Wavelength	660 nm±10 nm, 785 nm±10 nm		
Incident angle	0 °±5 °		
Dimensions	3.0×3.0×3.0 (mm)		
Clear aperture	φ2 mm		
Wavefront aberration	0.02 λrms Max. (Transmission, λ:660 nm)		
Dichroic coating characteristic	Wavelength	Incident angle	Characteristics
	660 nm	0 °	Tp≥90 % Ts≥90 %
	785 nm	0 °	Rp≥88 % Rs≥92 %
Reflectance of AR coating	0.5 % Max. (Incident angle:0 °)		

### Spectral Characteristics



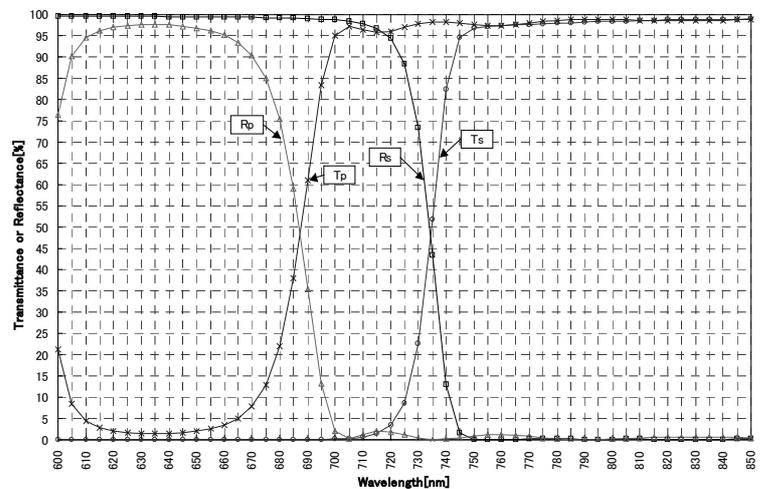
Tp: Transmission P polarization      Rp: Reflection P polarization  
Ts: Transmission S polarization      Rs: Reflection S polarization

## MSK053C

### Specifications

Material	BK7 or equivalent		
Wavelength	660 nm±10 nm, 785 nm±10 nm		
Incident angle	0 °±5 °		
Dimensions	3.0×3.0×3.0 (mm)		
Clear aperture	φ2 mm		
Wavefront aberration	0.02 λrms max (Reflection, λ:660 nm)		
Dichroic coating characteristics	Wavelength	Incident angle	Characteristics
	660 nm	0 °	Rp≥80 % Rs≥97 %
	785 nm	0 °	Tp≥94 % Ts≥94 %
Reflectance of AR coating	0.5 % Max. (Incident angle:0 °)		

### Spectral Characteristics



Tp: Transmission P polarization      Rp: Reflection P polarization  
Ts: Transmission S polarization      Rs: Reflection S polarization

OPTICAL DEVICE

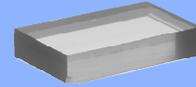
# Dichroic Mirror (MSK387C)

- Reflective against both CD and DVD
- Controls retardation in reflectance

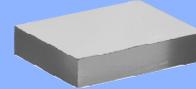
# Dichroic Plate (MSK861)

- Monitors beam power of both CD and DVD

Dichroic Mirror



Dichroic Plate

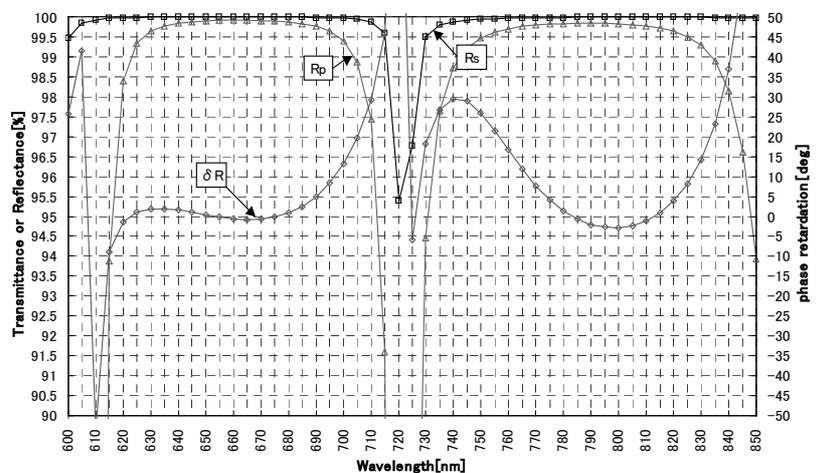


## Dichroic Mirror (MSK387C)

### Specifications

Material	B270 or equivalent		
Wavelength	660 nm±10 nm, 785 nm±10 nm		
Incident angle	45 °±5 °		
Dimensions	6.0×4.0×2.0 (mm)		
Clear aperture	5×3 mm Ellipse		
Wavefront aberration	0.02 λrms Max. (Reflection, λ:660 nm, φ3 mm)		
Mirror coating characteristics	Wavelength	Incident angle	Characteristics
	660 nm	45 °	Rp≥97 % Rs≥97 % δR=0 °±10 °
	785 nm	45 °	Rp≥97 % Rs≥97 % δR=0 °±10 °

### Spectral Characteristics



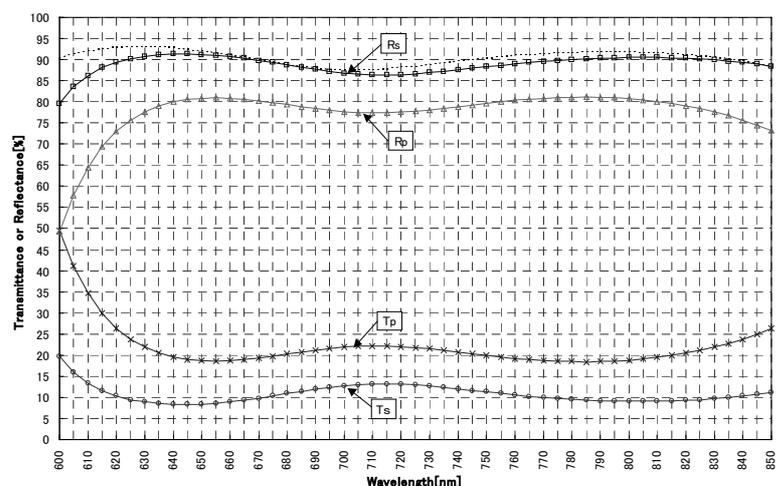
Tp: Transmission P polarization    Rp: Reflection P polarization  
Ts: Transmission S polarization    Rs: Reflection S polarization

## Dichroic Plate (MSK861)

### Specifications

Material	B270 or equivalent		
Wavelength	660 nm±10 nm, 785 nm±10 nm		
Incident angle	35 °±5 °		
Dimensions	6.0×4.0×2.0 (mm)		
Clear aperture	5×3 mm Ellipse		
Wavefront aberration	0.02 λrms Max. (Reflection, λ:660 nm, φ3 mm)		
Dichroic coating characteristics	Wavelength	Incident angle	Characteristics
	660 nm	35 °	Tp=20±5 % Ts=10±5 % Rp=80±5 % Rs=90±5 %
	785 nm	35 °	Tp=20±5 % Ts=10±5 % Rp=80±5 %
Reflectance of AR coating	2.0 % Max. (Incident angle:35 °)		

### Spectral Characteristics



Tp: Transmission P polarization    Rp: Reflection P polarization  
Ts: Transmission S polarization    Rs: Reflection S polarization

**OPTICAL DEVICE**

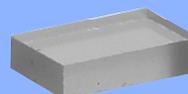
# Grating

- Customer designs available upon request

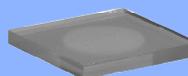
# Dichroic Filter

- Allows the DVD and CD wavelength transmit selectively

Grating



Dichroic Filter

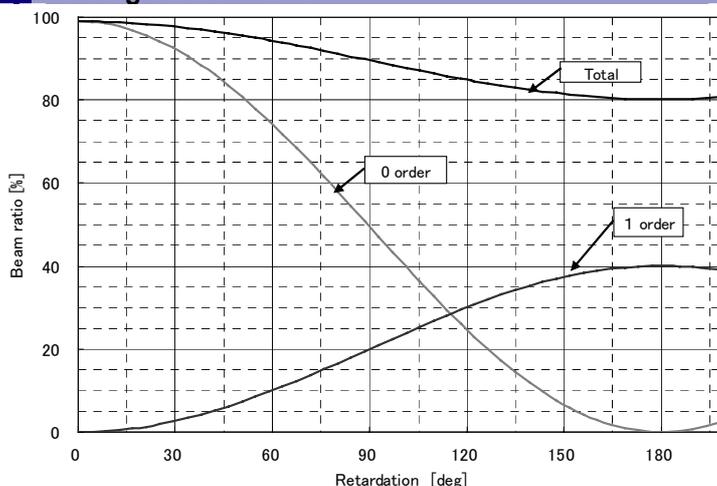


## Grating

### Specifications

Material	Non-alkaline glass
Wavelength	660 nm±10 nm, 785 nm±10 nm
Dimensions	3.0 <sup>±0.1</sup> ×2.0 <sup>±0.1</sup> (mm) Other dimensions upon request
Thickness	0.3 <sup>±0.05</sup> , 0.5 <sup>±0.05</sup> (mm)
Grating pitch	20 μm (Duty 1:1) Other pitches upon request
Wavefront aberration	0.02 λrms Max. (λ:660 nm, φ1.4 mm)
Grating ratio	-1 order:0 order:+1 order=1:10:1 Other ratio upon request
Reflectance of AR coating	0.5 % Max. (Incident angle:0 °)

### Grating Characteristics

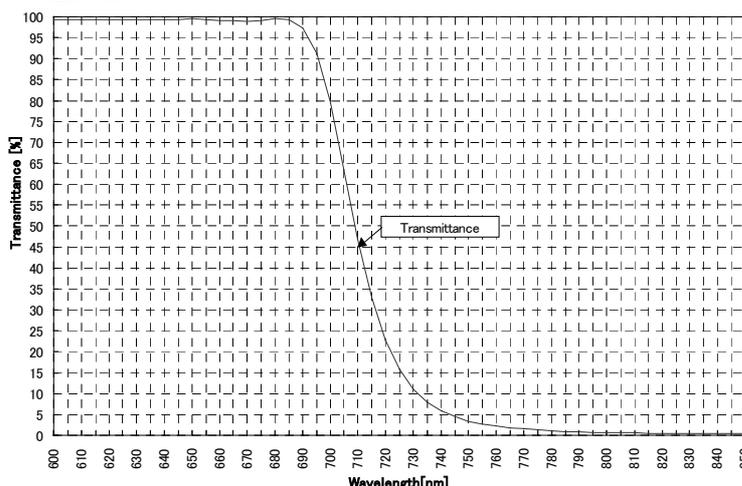


## Dichroic Filter

### Specifications

Material	Non-alkaline glass		
Wavelength	660 nm±10 nm, 785 nm±10 nm		
Wavelength	4.0 <sup>±0.1</sup> ×4.0 <sup>±0.1</sup> (mm) Other dimensions upon request		
Thickness	0.3 <sup>±0.05</sup> , 0.5 <sup>±0.05</sup> (mm)		
Wavefront aberration	0.025 λrms Max. (λ:660 nm, φ2.0 mm)		
Transmittance	Peripheral area	Wavelength	Characteristics
		660 nm	≥95 %
	Center	660 nm	≤5 %
		785 nm	≥95 %
Reflectance of AR coating	0.5 % Max. (Incident angle:0 °)		

### Spectral Characteristics



## OPTICAL DEVICE

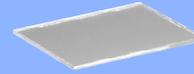
# OLPF

## IR-cut Filter (MSK847)

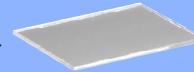
## UV·IR-cut Filter (MSK763)

- Sharply cut the infrared ray

OLPF  
IR-cut Filter



OLPF  
UV·IR-cut Filter

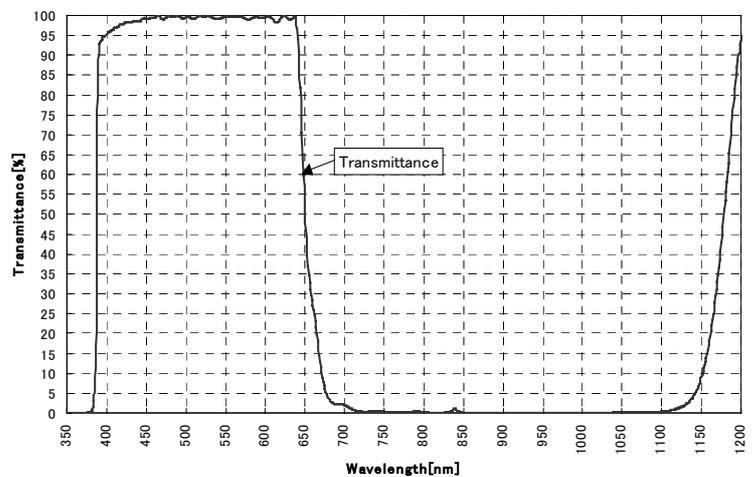


### IR-cut Filter (MSK847)

#### Specifications

Material	Synthetic Quartz ,glass
Wavelength	400 nm to 1200 nm
Dimensions	8.0 <sup>±0.05</sup> ×7.0 <sup>±0.05</sup> (mm) other dimensions upon request
Accuracy against optical axis	Angle of optical axis(from cutting) 45 °±1 °
	Separation angle±1 °
IR-cut filter characteristics	50 % wavelength of IR : 650 nm±10 nm
Reflectance of AR coating	1.0 % Max. (Incident angle:0 °,λ=400 nm - 680 nm)

#### Spectral Characteristics

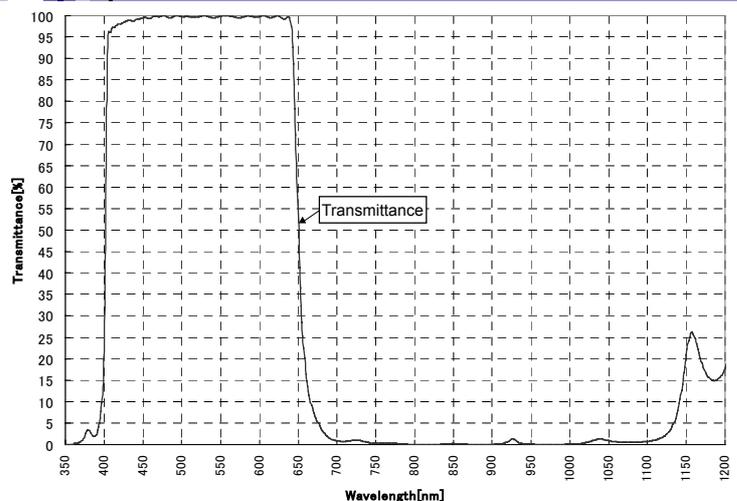


### UV·IR-cut Filter (MSK763)

#### Specifications

Material	Synthetic Quartz ,glass
Wavelength	400 nm to 1200 nm
Dimensions	8.0 <sup>±0.05</sup> ×7.0 <sup>±0.05</sup> (mm) other dimensions upon request
Accuracy against optical axis	Angle of optical axis(from cutting) 45 °±1 °
	Separation angle ±1 °
UV·IR-cut filter characteristics	UV:50 % Wavelength :400 nm±10 nm IR :50 % Wavelength :650 nm±10 nm
Reflectance of AR coating	1.0% Max. (Incident angle:0 °,λ=400 nm - 680 nm)

#### Spectral Characteristics



OPTICAL DEVICE

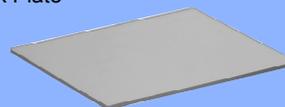
# Heat Sink Plate

- High transmission

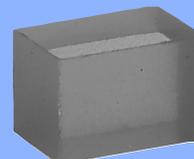
# Etalon Filter

- Keep the loss low
- Stable against temperature

Heat Sink Plate



Etalon Filter



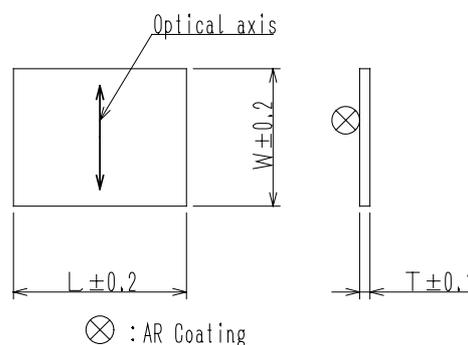
## Heat Sink Plate

### Specifications

Material	Synthetic Quartz
Wavelength	420 nm to 680 nm
Accuracy against optical axis	Angle between optical axis and L 90 °±0.5 °
	Angle between optical axis and W 0 °±0.5 °
Reflectance of AR coating	1.0 % Max.(Incident Angle:0 °)

### Outline Drawing

(Unit:mm)



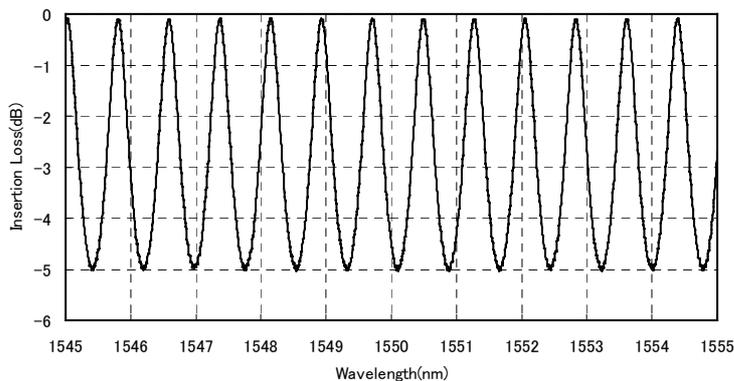
L	W	T
20.0	18.0	on discussion
23.5	16.0	
23.5	20.0	
26.0	21.0	
28.0	22.0	

## Etalon Filter

### Specification

Material	SiO <sub>2</sub>
Wavelength	1500 nm to 1610 nm
Dimensions	Upon request
FSR	100 GHz
Insertion loss	≤0.5 dB
Thermal Stability	10 pm/°C

### Etalon Characteristics(100GHz)



# WORKING FOR Pb FREE

## ■Pb Free Policy of QD products and Implementation Schedule

### ●Implementation Schedule

1. EPSON TOYOCOM started to manufacture Pb free products in April,2002.
2. For the products in mass production now, EPSON TOYOCOM will switch to Pb Free Products with customer's approval.
3. When ordering, please specify if Non-Pb Free products are desired.  
Pb free products are EPSON TOYOCOM's standard.

### ● Eliminated Pb

〈 Basic policy 〉

“Lead in solder” means Soldering- paste for electronic circuit board & Solder Plating on the outer-lead of products.

Products	Notes
<p>●Complete Pb free products.</p> <p>Cylinder type      Metal Cap type      Metal can type</p> 	Pb used in these products is eliminated.
<p>●Pb free terminal products</p> <p>Plastic package type products</p> 	These products use Pb in high melting temperature type solders or contain Pb in sealing glass exempted by RoHS directive.
<p>●Current Pb free terminal products</p> <p>FC Series      FA-365</p> 	Some ceramic package products are already Pb-free terminal type of product, but contain Pb in sealing glass exempted by RoHS directive.
<p>●Current complete Pb free products</p> 	Ceramic package products with metallic lid are already completely Lead-free type of product.

## ■DISTINCTIONS

### ●Distinctions between current products and Pb free products. \*1

Appearance

- Plastic package type products.

Marking (year part lot No.) will be changed as follows.

Current	Numeric	1	2	3	4	5	6	7	8	9	0
Pb free	Alphabet	A	B	C	D	E	F	G	H	J	K

- Cylinder type products

The glass color of plug will be changed as follows.

Current	Blue or Green etc
Pb free	Gray or White

〈 Exception 〉

\*1 Ceramic package type products are originally Pb free terminal designed, so there are no change.

## ■Pb Free materials of QD products

Pb Free products are complied with RoHS directive.

When ordering, please specify if Non-Pb Free products are desired.

	Model	Terminal Material	Terminal Plating	Complete Lead free	Remarks
kHz range Crystal units	C-xxxx Series	Fe-Ni-Co	Sn-Cu	○	
	FC-xxx Series	W	Au		Contains Pb in sealing glass exempted by RoHS directive.
	MC-xxx Series	42Alloy	Sn-Bi		High melting temperature type solder. (Pb85%)
MHz range Crystal units	CA-301	Fe-Ni-Co	Sn-Cu	○	
	TSX-xxx Series	W	Au	○	
	FA-238V / 238	W	Au	○	
	FA-365	W	Au		Contains Pb in sealing glass exempted by RoHS directive.
	MA-xxx Series	42Alloy	Sn-Bi		High melting temperature type solder. (Pb85%)
Resonator	NS-xxx Series	W	Au	○	
	FS-xxx Series	W	Au	○	

	Model	Terminal Material	Terminal Plating	Complete Lead Free	Definitions
SPXO	SG-350 Series	42Alloy	Sn-Bi	○	
	SG-550 Series	42Alloy	Sn-Bi	○	
	SG-310 Series	W	Au	○	
	SG-645 Series	42Alloy	Sn-Bi		High melting temperature type solder. (Pb85%)
	SG-710 Series	W	Au	○	
	SG-636 / 615 Series	42Alloy	Sn-Bi		High melting temperature type solder. (Pb85%)
	SG-51 / 531 Series	42Alloy	Sn-Bi		High melting temperature type solder. (Pb85%)
	SG-xxxxLA Series	42Alloy	Sn-Bi	○	
	SG-xxxxLB Series	42Alloy	Sn-Bi	○	
	SG-xxxxJC Series	42Alloy	Sn-Bi		High melting temperature type solder. (Pb85%)
	SG / HG-xxxxJA Series	42Alloy	Sn-Bi		High melting temperature type solder. (Pb85%)
	SG-xxxxJF Series	42Alloy	Sn-Bi		High melting temperature type solder. (Pb85%)
	SG-xxxxLC Series	42Alloy	Sn-Ag		Contains Pb in sealing glass exempted by RoHS directive.
	SG-xxxxCE Series	W	Au	○	
	SG / HG-xxxxCA Series	W	Au	○	
	TCO-708x Series	W	Au	○	
	TCO-7116H1A	W	Au	○	
	TCO-711A7 / 743 Series	Fe-Ni-Co	Sn-Cu	○	
	TCO-7106X1A / 7107X1A	W	Au	○	
	TCO-391B/C Series	Sn-P-Cu	Sn-Cu	○	
	TCO-393F	Cu	Au	○	
	TCO-3100 Series / 3131	Sn-P-Cu	Sn-Cu	○	
	XG-xxxxCA / CB Series	W	Au	○	
EG-xxxxCA Series	W	Au	○		
MG-5020JE	42Alloy	Sn-Ag		High melting temperature type solder. (Pb85%)	
MG-5100SA	42Alloy	Sn-Ag		High melting temperature type solder. (Pb85%)	
TCXO	TG-xxxxLA / LH Series	42Alloy	Sn-Bi	○	
	TCO-5860 Series	W	Au	○	
	TCO-5890 Series	W	Au	○	
	TCO-5850 Series	W	Au	○	
	TCO-5060 / 5160 Series	W	Au	○	
VCXO	VG-xxxxCA Series	W	Au	○	
	VG-xxxxJA Series	42Alloy	Sn-Bi		High melting temperature type solder. (Pb85%)
	TCO-734A / 735 Series	Fe-Ni-Co	Sn-Ag-Cu	○	
	TCO-7302 Series	Fe-Ni-Co	Sn-Ag-Cu	○	
	TCO-291 Series	Sn-P-Cu	Sn-Cu	○	
	TCO-293 Series	Cu	Au	○	
	TCO-294J	Cu	Au	○	
	TCO-296 Series	Cu	Au	○	
	TCO-2000 / 2100 Series	Sn-P-Cu	Sn-Cu	○	
	TCO-2106 / 2107	Sn-P-Cu	Sn-Cu	○	
	TCO-2110 Series / 2131	Sn-P-Cu	Sn-Cu	○	
	TCO-2152	Ag-Pd	Au	○	
	TCO-726 / 7026 Series	W	Au	○	
	TCO-756 BVX7 / DVX7	Fe-Ni-Co	Sn-Cu	○	
TCO-7116 Series	W	Au	○		
TCO-7106Z1Z	W	Au	○		
OCXO	TCO-6602	Fe-Ni(50%)	Sn-Cu	○	
	TCO-6730				
	TCO-676				
	TCO-6920				
	TCO-679	Fe-Ni-Co	Sn-Ag-Cu	○	
PLL Module	TCM-2021Series	Cu	Au	○	
Real Time Clock Module	RX / RTC-xxxxSA Series	42Alloy	Sn-Ag		High melting temperature type solder. (Pb85%)
	RX / RTC-xxxxNB Series	Cu Alloy	Sn-Ag		High melting temperature type solder. (Pb85%)
	RX / RTC-xxxxJE Series	42Alloy	Sn-Ag		High melting temperature type solder. (Pb85%)
	RX-xxxxLC Series	42Alloy	Sn-Ag		Contains Pb in sealing glass exempted by RoHS directive.
	RTC-4543SB	42Alloy	Sn-Ag		High melting temperature type solder. (Pb85%)
	RTC-7301SF	Cu Alloy	Sn-Ag		High melting temperature type solder. (Pb85%)
	RTC-62423 / 72423	42Alloy	Sn-Bi		High melting temperature type solder. (Pb85%)
Crystal Filter (MCF)	TFx- Series	W	Au	○	
	TSx- Series	W	Au	○	
SAW Filter	FF-xxx Series	W	Au	○	
	TQS Series	W	Au	○	
Sensor	XV-3500CB	W	Au	○	
	HTS-206	Fe-Ni-Co	Sn-Pb		High melting temperature type solder. (Pb85%)
	TSU-10GL/20G/70G/100G	Cu	Sn	○	Terminal that joined pressure.

## HANDLING PRECAUTIONS

When using EPSON TOYOCOM products, it is essential to observe the operating conditions specified in their respective specifications or catalogs.

### Common points for all products

#### 1. Shock resistance

EPSON TOYOCOM's crystal products are designed to resist physical shocks, but crystal products may be damaged under some conditions, such as dropping from desks or receiving shocks during mounting. Please be sure to re-check the characteristics if product has received any shocks.

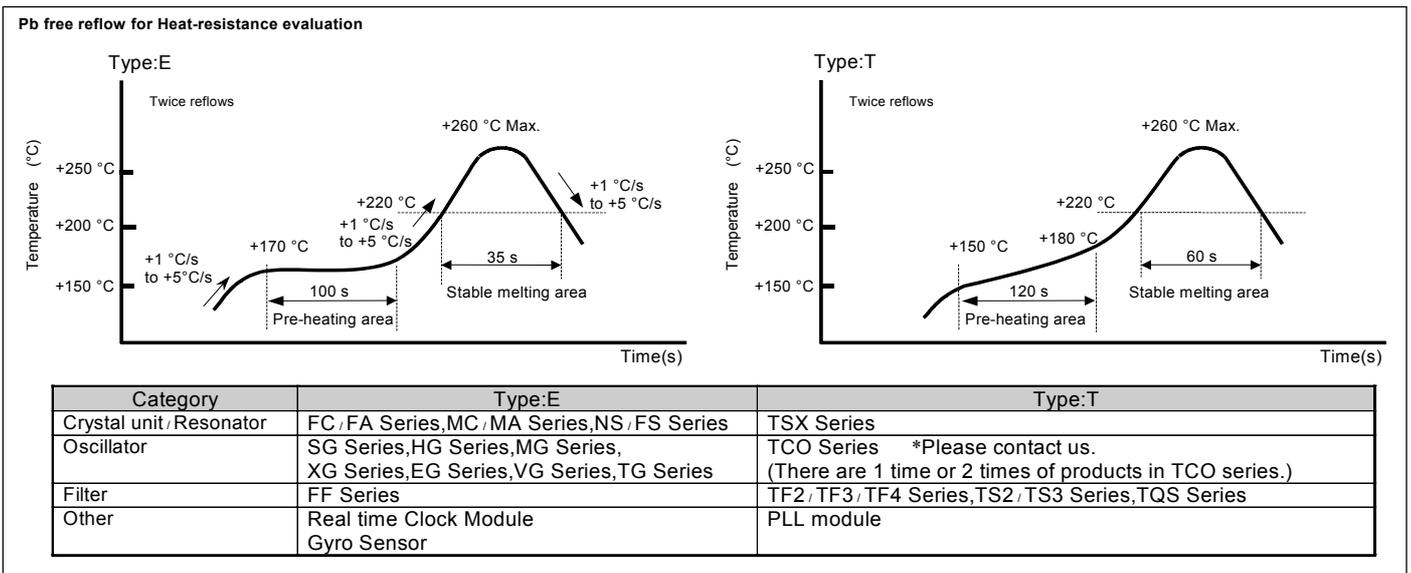
#### 2. Soldering heat resistance

EPSON TOYOCOM's crystal products except SMD products use solder having a +180°C to +200°C melting point. Heating up the package more than +150°C may deteriorate the characteristics or damage the products. If the crystal products need to be soldered at temperature of more than +150°C, SMD products are recommended. Using higher temperatures over the following reflow conditions to crystal products, even SMD products, may cause the characteristics to deteriorate. The reflow conditions within following profile is recommended. Always check the soldering temperature and time before mounting these products. Also, please check them again when the mounting conditions are changed. Please contact us for inquiries about heat-resistance if crystal products need to be soldered over the following profile.

(1) Cylinder products and DIP products

Model	Soldering conditions
[ Cylinder ] C-TYPE, C-2-TYPE, C-4-TYPE, HTS-206	+280 °C or under @ max. 5 s. Do not heat the package at more than +150 °C.
[ Cylinder ] CA-301 [ DIP ] SG-51 / 531, SG-8002DB / DC, RTC-62421 / 72421 / 7301DG, TCO-711A7, TCO-743A7 / HC7, TCO-756BVX7, DVX7 TCO-734A / 735 / 7302	+260 °C or under @ max. 10 s. Do not heat the package at more than +150 °C.

(2) SMD products Reflow profile (example)



Please make temperature rate as gentle a curve as possible. Also, if the package is cellular, the possibility of cracking is inevitable, so please store it for a short duration and take measures to protect product from dampness when you store it in high humidity.

### 3. Mounting precautions

#### Shocks by auto mounting

Shocks caused by auto mounting and vacuuming may deteriorate the characteristics and affect the products. Please set the mounting conditions to minimize the shocks as much as possible, and be sure that there is no affect on the characteristics before mounting. Please review the conditions after the conditions are changed. Also please be sure that crystal products don't hit machines or other electric boards, etc. before or after mounting.

(1) a) Ceramic package products and SON products

Bending the board after soldering ceramic package products and SON products (MC-146, RTC-\*\*\*\*NB, RX-\*\*\*\*NB) may cause peeling off portions of soldering or package cracks by mechanical stress. Particularly, in the case of cutting boards after soldering these products, please be sure to layout the crystal on a less stressed location and use less stressed cutting method.

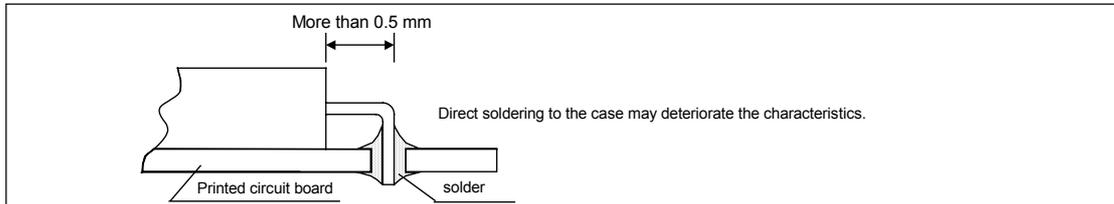
b) Ceramic package products

In the case of soldering ceramic package products on a different expansion-coefficient board (ex. Epoxy Glass), soldering crack at the foot pattern would be expected under repeated temperature changes for a long period. Under these conditions, be sure to check the solderability in advance.

## (2) Cylinder products

Bending the lead on the glass or pulling the lead strongly may cause cracking of the hermetic seal glass at the root of the lead and may cause the airtightness and the characteristics to deteriorate. When the lead of crystal products need to be bent as in the figure below, leave more than 0.5mm of lead from the case and hold the lead to prevent the lead from cracks. When the lead needs to be repaired, do not pull it, and hold the bent part to correct it. Giving undue pressure on this portion of hermetic seal may cause the airtightness to deteriorate. Please avoid applying pressure. Gluing the case of products on the electric board is recommended to prevent the airtightness from deteriorating.

### ● Installation example



## (3) DIP products

Deformed leads cannot be inserted into board holes. Avoid applying stress sufficient to deform leads.

## (4) SOJ Products and SOP products

Please avoid applying stress sufficient to deform the leads.

Deformed leads may cause incorrect soldering.

Particularly SOP products need to be handled with the greatest care.

## 4. Ultrasonic cleaning

- Products using AT-cut crystal and SAW resonator/filter can be cleaned by ultrasonic. But under some conditions, the crystal characteristics may be affected and internal wiring may be damaged. Please be sure to check the suitability of your system in advance.
- Products using tuning-fork crystals cannot be guaranteed if cleaned using ultrasonic methods, because crystal may be destroyed.
- Do not wash open-type products.
- With washable products, avoid the use of cleaners or solvents that may negatively affect the product.

## 5. The affect of mechanical vibration

While there is any given shock or mechanical vibration periodically to crystal products, such as, a piezo sounder, a piezo buzzer, and speaker, to crystal products, output frequency and amplitude can be changed. Especially the quality of telecommunication equipment could be affected by this phenomenon. Although EPSON TOYOCOM's crystal products are designed to minimize the effect of mechanical vibration, EPSON TOYOCOM recommends to check them in advance and then follow the Mounting guidelines as below.

### ● Mounting guidelines

- (1) Ideally, the mechanical buzzer source should be mounted on a separate PCB from the crystal device.
- (2) It is advisable to use cushion or cutting PCB, if you mount on same PCB.
- (3) Traveling mechanical vibration differs when applied to the PCB only vs. inside the body. Last of all, it is advisable to conform to inside body characteristics.

## 6. Storage

- (1) Storing the crystal products under higher or lower temperature or high humidity for a long period may affect frequency stability or solderability. Please store the crystal products at the normal temperature and humidity, avoid storing them for a long period and mount them as soon as possible after unpacking.

### Normal temperature and humidity:

Temp, +15 °C to +35 °C, humidity 25 % RH to 85 % RH (refer to the standard conditions of test site JIS Z-8703)

- (2) Please carefully handle the inner and outer boxes and reel. External pressure may cause deformation of reel and tape.

## 7. Radiation

Exposure to radiation can cause deterioration in performance, so avoid irradiation.

## 8. Chemicals / pH

Do not use or store the product in a pH range that may cause corrosion or dissolution of the materials or packaging.

## 9. Adhesive

Do not use an adhesive that may cause corrosion of the packing materials, terminals, components, glass materials, and vapor deposited materials used in the products.

(For example, a chlorine-based adhesive may corrode the metal parts "lid" of a crystal unit to diminish the hermetic qualities, lowering the performance.)

## 10. Halogen Compound

Do not use the product in any amount of halogen gas, even in a slight amount of halogen gas such as that found in chlorine gas in the air, as the metal parts used in the package may corrode. Also, do not use any resin that emits halogen gas.

## ■ Crystal unit / Resonator

### 1. Drive level

Applying excessive drive level to the crystal units may cause deterioration of characteristics or damage. Circuit design must be such as to maintain a proper drive level.(refer to page 162 "Drive level")

### 2. Negative resistance

Unless adequate negative resistance is allocated in the oscillation circuit, oscillation or oscillation start up time may increase (refer to page 162 "Allowance for Oscillation".)

### 3. Load capacitance

Differences in the load capacitance in the oscillation circuit may result in deviations in the oscillation frequency from the desired frequency. Attempting to tune by force may merely cause abnormal oscillation. Before use, please specify the load capacitance of the oscillation circuit.(refer to page 162 "Load capacitance" )

## ■ Crystal Oscillator and real time clock module

All crystal oscillators and real time clock modules are provided with a CMOS IC. Please pay attention to the following points.

### 1. Static electricity

Although an anti-static-electricity protection circuit is provided in the circuit, excessive levels of static electricity may damage the IC. Choose conductive materials for containers and packing material. Use a soldering gun and a measuring circuit free from high-voltage leakage and provide grounding connection when working with them.

### 2. Noise

Applying excessive level of extraneous noise to power source or input terminal may cause latch up or spurious phenomenon, which results in malfunction and breakdown.  
To maintain stable operation, provide by-pass capacitor with more than 0.1  $\mu\text{F}$  at a location as near as possible to the power source terminal of the crystal products (between Vcc - GND). Do not permit any objects which emit a high level of noise in a location near the crystal oscillator.

### 3. Power supply line

Line impedance of a power supply should be as low as possible.

### 4. Output Load

It is recommended that output load is installed as close as possible to an oscillator (within 20 mm).

### 5. Treatment of unused input terminals

Unused pins that are left open may collect noise, thereby resulting in malfunction. Also, power consumption may increase when both P-channel and N-channel are turned on, therefore connect unused input terminals to Vcc or GND.

### 6. Heat impact

Repeated large changes in temperature may degrade the characteristics of a deteriorated crystal unit and cause breakage of wires inside the plastic mold. This must be avoided.

### 7. Mounting direction

Incorrect mounting of the oscillator may cause malfunction and breakdown, so please check the mounting direction when installing.

### 8. Power on

It is not recommended to power on from intermediate electric potential and / or extreme fast power on. Powering on under such conditions may cause no oscillation and / or malfunction.

## ■ Optical device

### 1. Chemicals

Do not use chemicals that may negatively affect the glass materials, vapor deposited materials, or adhesives used in the product.

# PRECAUTIONS IN DESIGNING OSCILLATION CIRCUITS

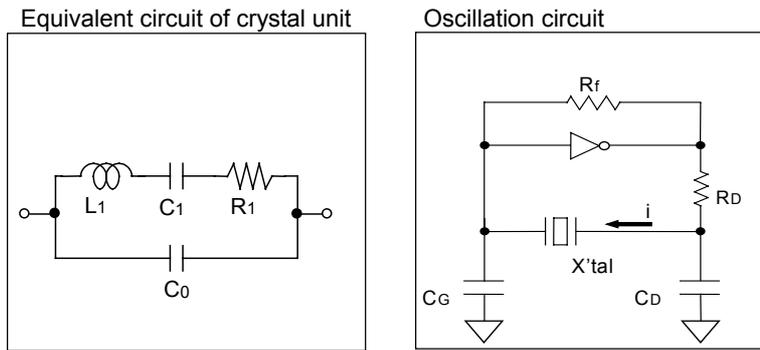
## 1. Drive level

Drive level denotes electric power required to oscillate a crystal unit, which can be calculated using the following formula.

$$\text{Drive level ( P )} = i^2 \cdot R_e$$

Where  $i$  stands for current to pass in the crystal unit,  $R_e$  for effective resistance of crystal unit, and  $R_e = R_1(1 + C_0/C_1)^2$ .

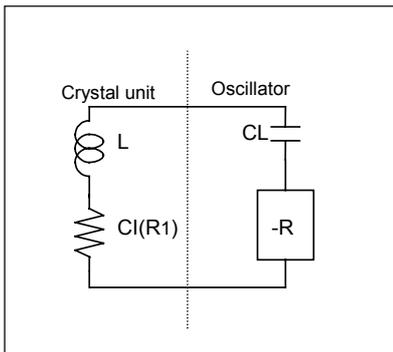
If the Drive level (P) exceeds the specified level, oscillation frequency will shift. This occurs because an excessive level of power causes stress for the crystal and, consequently, temperature rises. If excessive drive level of power is applied to the crystal unit, this may deteriorate or damage the characteristics.



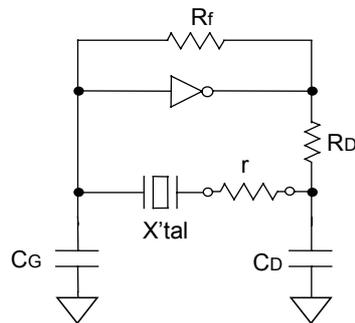
## 2. Allowance for oscillation

Unless adequate negative resistance is allocated in the oscillation circuit, oscillation start-up time may be increased, or No oscillation may occur. In order to avoid this, provide enough negative resistance in the circuitry design.

### ● Crystal unit and Oscillator



### ● Check of Negative resistance



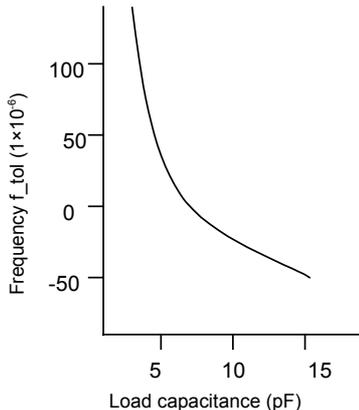
1. Connect the resistance (r) to the circuit in series with the crystal unit.
2. Adjust (r) so that oscillation can start (or stop).
3. Measure (r) when oscillation just starts (or stops) in (2) above.
4. Recommended (r)  
 $(r) > C_1 \times (5 \text{ to } 10)$

## 3. Load capacitance

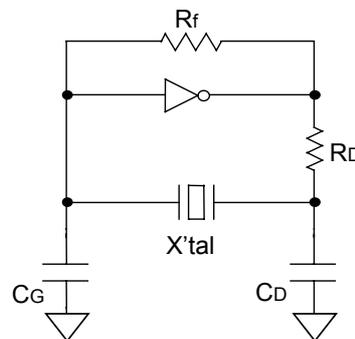
Differences in the load capacitance of the oscillation circuit may result in a different oscillation frequency from the desired one, as shown in the figure below. Approximate expression of the load capacitance of the circuit  $C_L \cong C_G \times C_D / (C_G + C_D) + C_s$ .

Where  $C_s$  stands for stray Capacity of the circuit.

### ● Frequency and load capacitance characteristics



### ● Reference for setting parameters of oscillation circuit

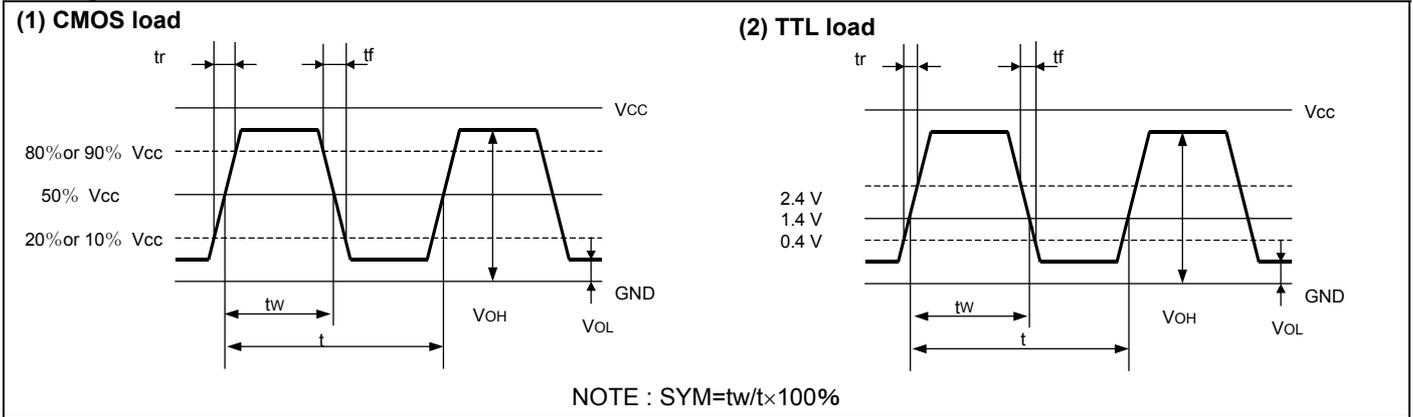


Symbol	Rf (MΩ)	Rd (kΩ)	Cg (pF)	Cd (pF)
Frequency range				
20 kHz to 60 kHz	20	500	10	10
60 kHz to 165 kHz	10	300	10	10
5.5 MHz to 30 MHz (Fundamental)	1	0.5	5~15	5~15
30 MHz~50 MHz (Fundamental)			5~10	5~10

IC: equivalent to TC74HCU04 (Unbuffer)  
 IC: equivalent to TC74VHCU04 (Unbuffer) (30 MHz to 50 MHz)  
 (TC74HCU04 and TC74VHCU04 are product number of Toshiba Corp.)

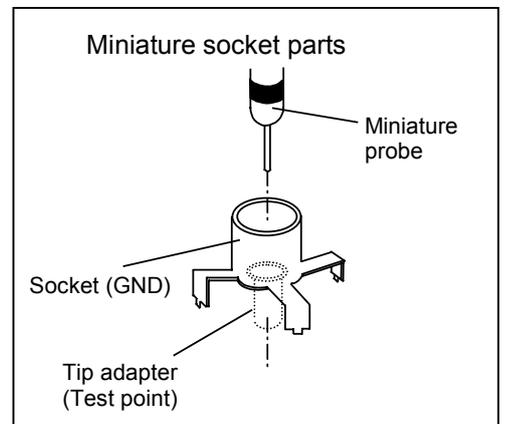
# OUTPUT WAVEFORM AND TEST CIRCUIT

## 1. Timing chart

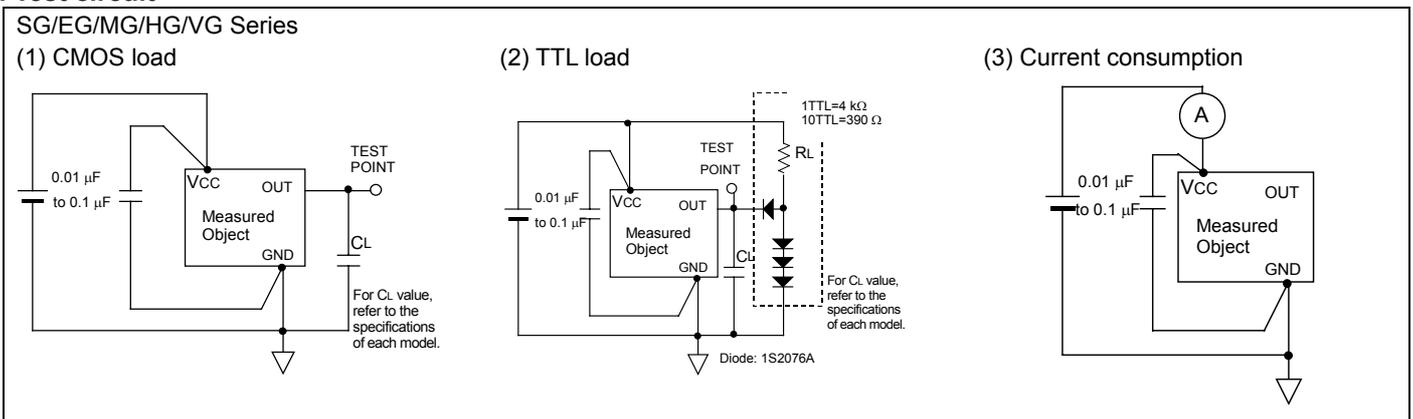


## 2. Test conditions

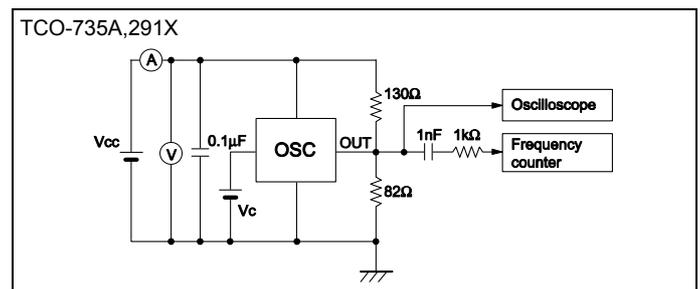
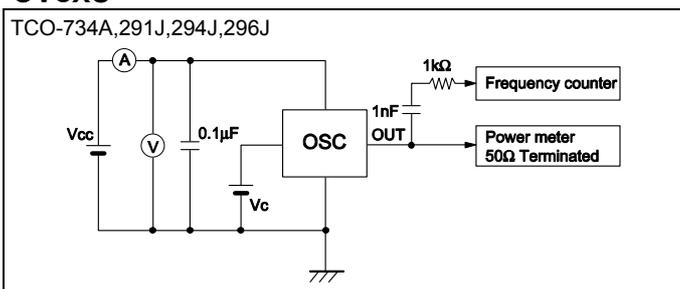
- (1) Supply voltage
  - More than 150 $\mu$ s until voltage level reaches 90 % from 0 %.
  - Supply voltage impedance is less than 2  $\Omega$  of resistance.
- (2) Oscilloscope
  - Input capacitance of less than 15 pF
  - Frequency range of 5 times or more of measurements frequency.
  - Earth lead of the probe should be as short as possible.
  - Probe impedance when measuring frequency is to be more than 1 M $\Omega$ . Simultaneous measurement is possible as the wave form passes from the amplifier stage of an oscilloscope.
- (3) MISCELLANEOUS
  - CL includes the probe capacitance.
  - Ammeter with small internal impedance should be used.
  - To observe wave form, please use a miniature socket. (do not use a long ground wire of the probe.)



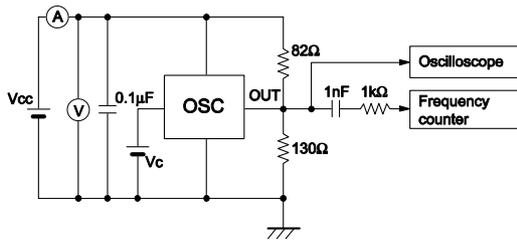
## 3. Test circuit



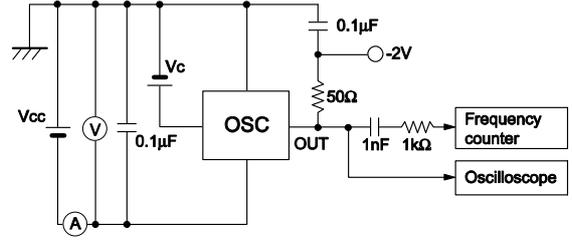
## VCXO



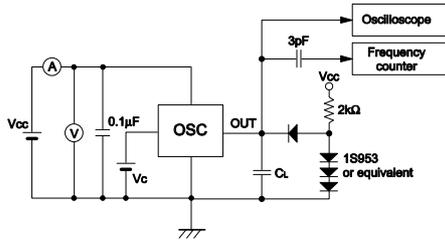
TCO-735B



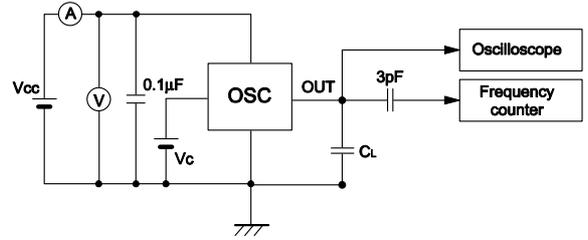
TCO-735C



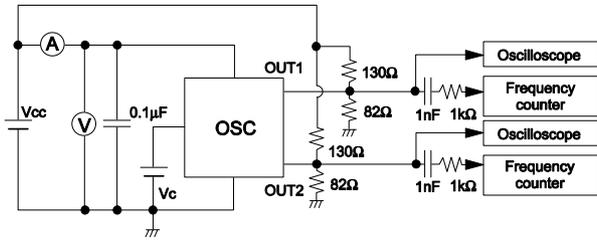
TCO-7302A,291B,B2,2001A,2002A,2101A,2102A



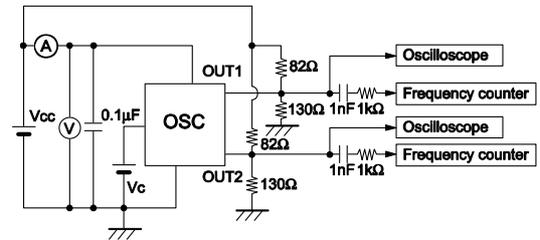
TCO-7302B,C,291C,C2,2003A,2004A,2103A,2104A



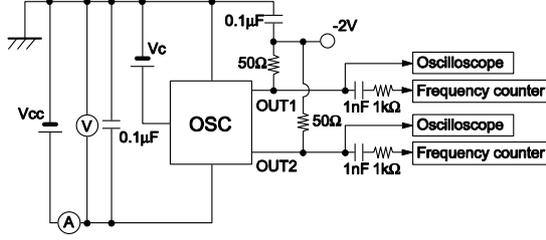
TCO-293A,296A,2111



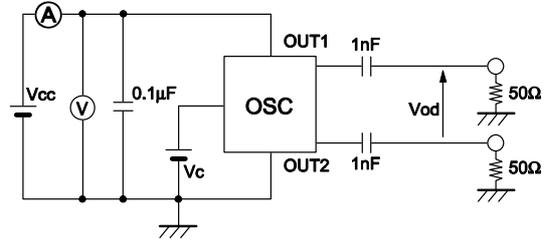
TCO-293B,2112



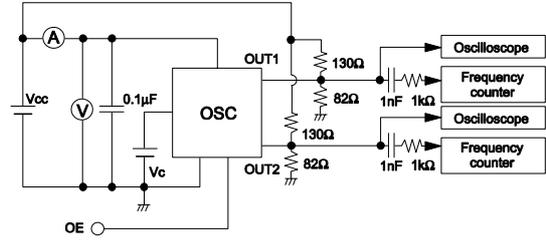
TCO-293C,2113



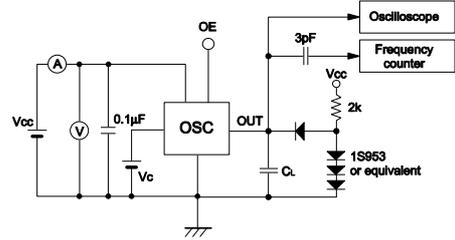
TCO-293D, 2114



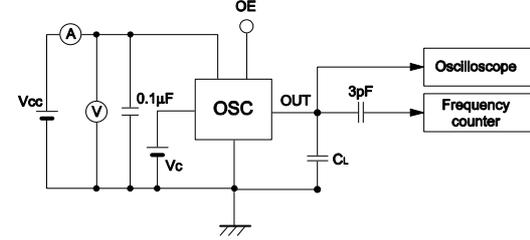
TCO-296X,2131,2152



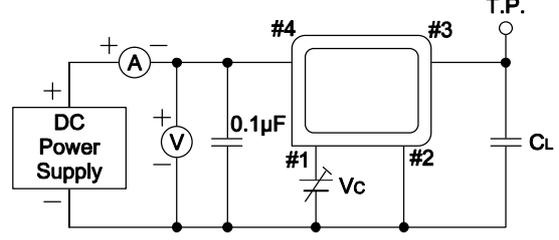
TCO-2106

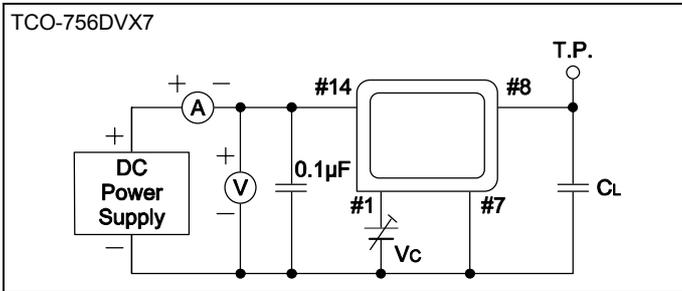
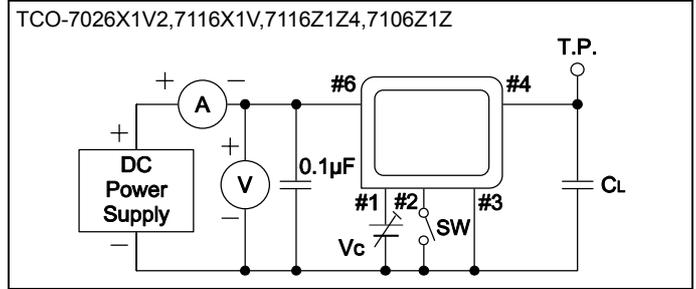
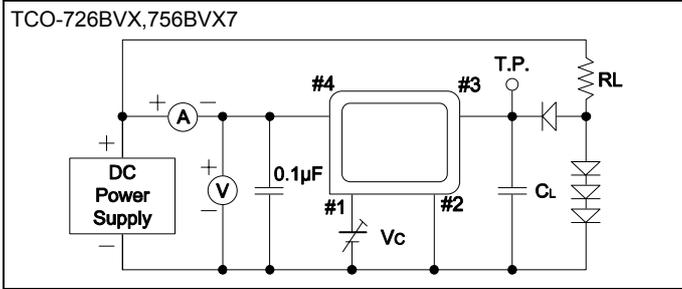


TCO-2107

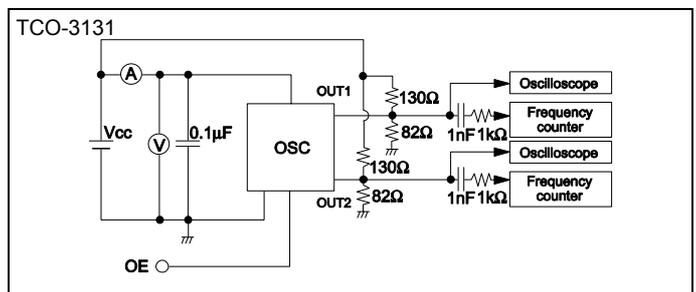
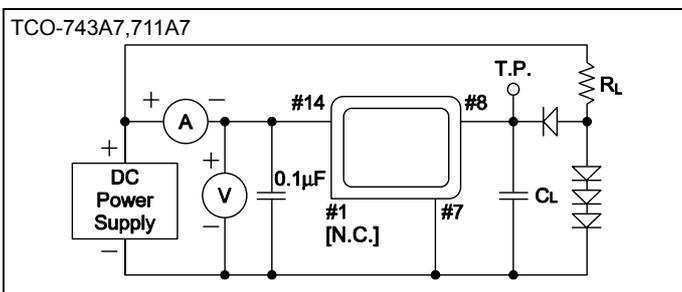
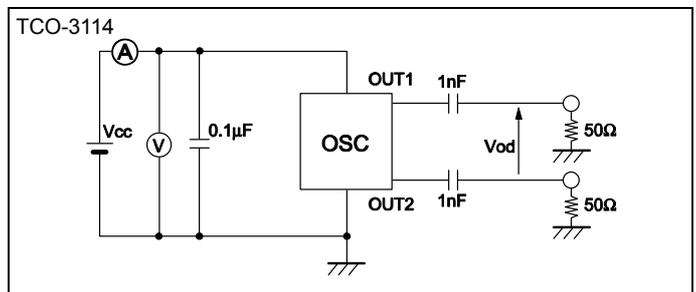
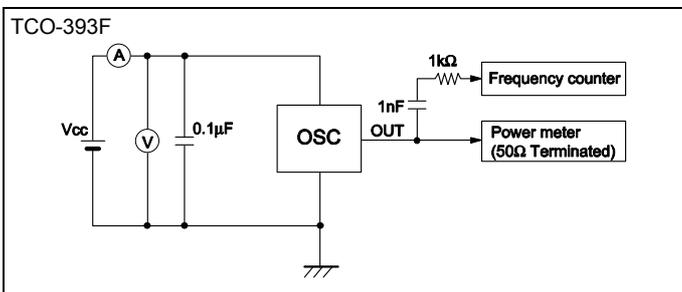
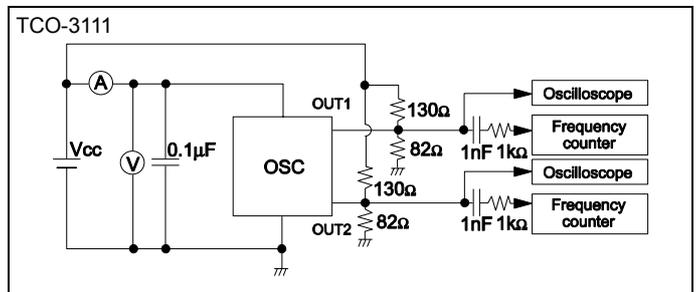
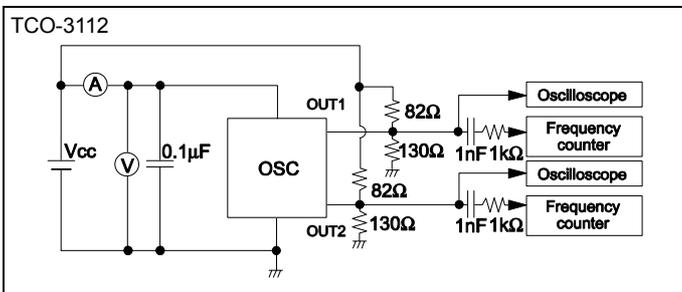
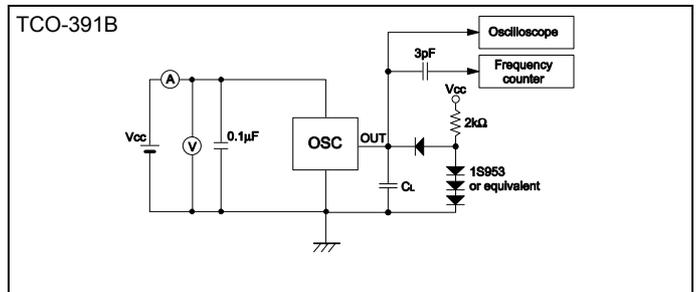
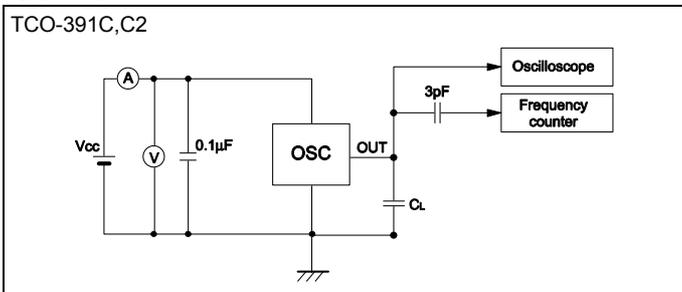


TCO-726DVX

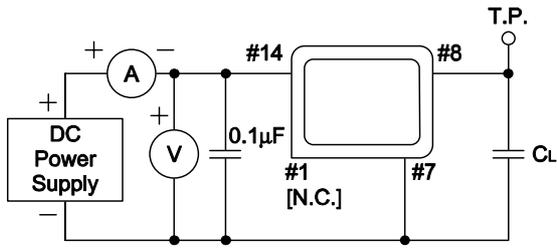




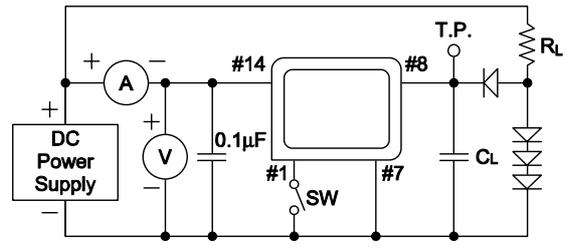
●SPXO



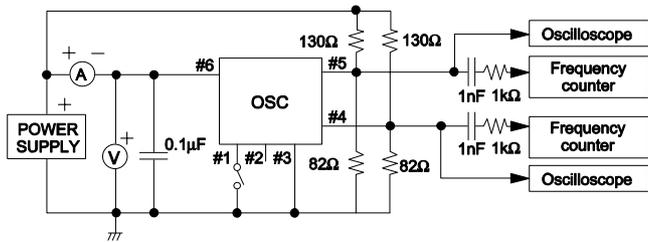
TCO-743HC7



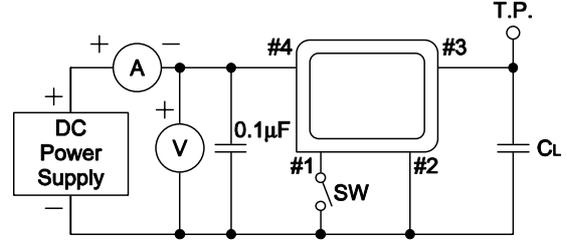
TCO-708\*A1A Series (\*:5~7)



TCO-7116H1A

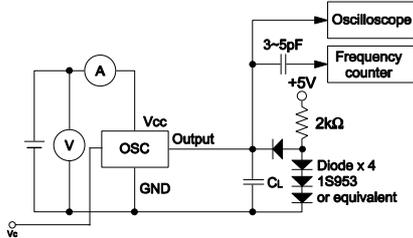


TCO-708\*D1A Series, 708\*X1A Series, 7107X1A Series (\*:5~7)

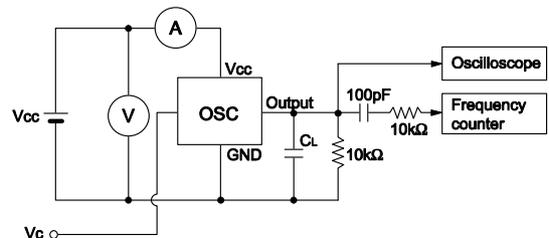


●OCXO

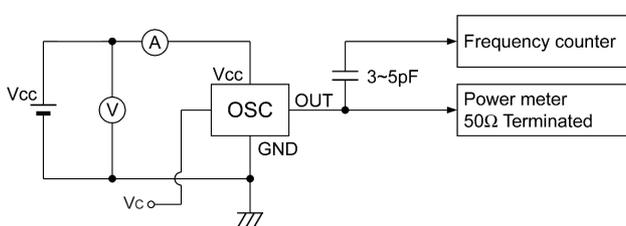
TCO-6730



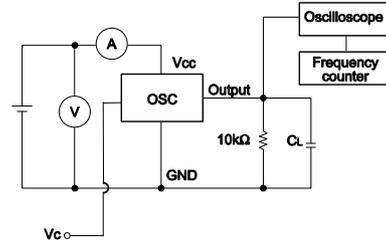
TCO-6602



TCO-6920

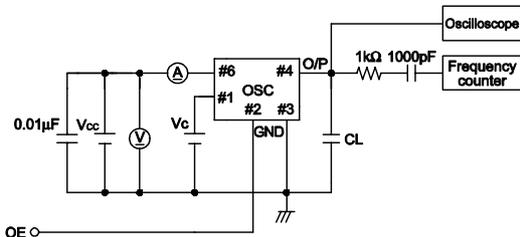


TCO-676,679

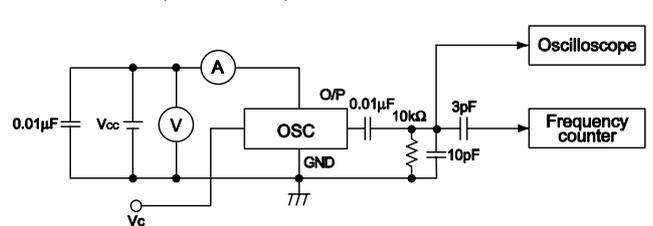


●TCXO

TCO-5060/5160 Series



TCO-5850 Series, 5860 Series, 5890 Series



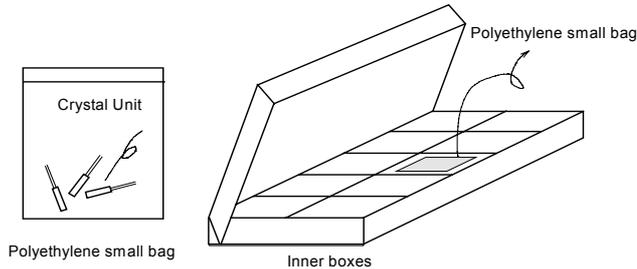
## STANDARD PACKING SPECIFICATIONS

For SMD products, standard packing quantity is specified as below table. Please order in accordance with packing quantity.

### 1. Cylinder

Cylinder products are packed in vinyl bags per lot of 250 to 1000pcs.  
From 1 to 20 bags are then placed in inner boxes to make a lot.

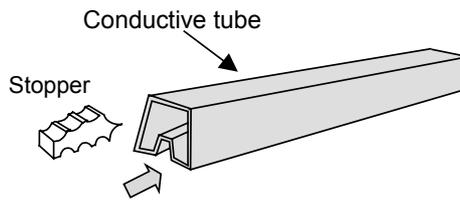
Inner boxes are then placed in cartons for shipment. ( the quantity varies with the model.)



Model	Quantity
C-001R	250 pcs / vinyl bags
C-2-TYPE C-4-TYPE C-002RX C-004R C-005R CA-301	500 pcs / vinyl bags

### 2. DIP

DIP products are placed into antistatic IC tubes and packed into boxes for shipment.

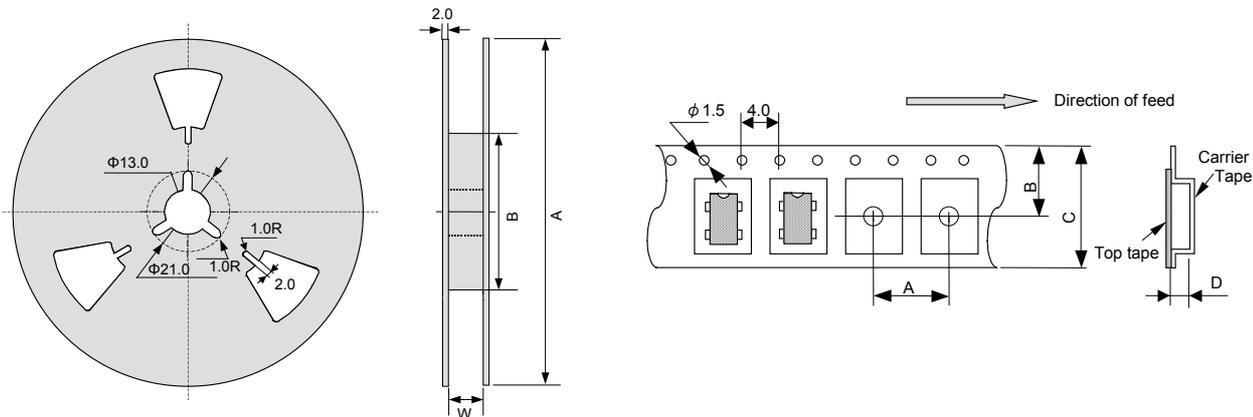


Model	Quantity
SG-531 SG-8002DC	35 pcs / tube
SG-51 SG-8002DB RTC-62421 RTC-72421 RTC-7301DG TCO-743 TCO-711 TCO-756	25 pcs / tube

Note: Please contact us for VCXO (TCO-734/735/7302).

### 3. SMD

SMD products are packed in the shipping carton as below table in accordance with taping standards EIA-481A and EIAJ RC-1009B.



## STANDARD PACKING QUANTITY and dimension (Unit:mm)

### ●Crystal Unit / Resonator

Model	Quantity (pcs/Reel)	Reel dimension			Career Tape dimension				Tape type (L=left direction)
		A	B	W	A	B	C	D	
FC-135	3000	$\phi 180$	$\phi 60$	13.0	4.0	7.25	12.0	1.0	TE1204L
FC-145	3000	$\phi 180$	$\phi 60$	13.0	4.0	7.25	12.0	1.0	TE1204L
FC-255	3000	$\phi 330$	$\phi 80$ or $\phi 100$	13.5	8.0	7.25	12.0	1.1	TE1208L
MC-146	3000	$\phi 330$	$\phi 80$ or $\phi 100$	17.5	8.0	9.25	16.0	1.7	TE1608L
MC-156	3000	$\phi 330$	$\phi 80$ or $\phi 100$	17.5	8.0	9.25	16.0	1.65	TE1608L
TSX-2520	2000	$\phi 180$	$\phi 60$	9.0	4.0	5.25	8.0	0.75	TE0804L
TSX-3225	2000	$\phi 180$	$\phi 60$	9.0	4.0	5.25	8.0	1.0	TE0804L
FA-238V/238/23H	3000	$\phi 180$	$\phi 60$	9.0	4.0	5.25	8.0	1.05	TE0804L
TSX-4025	2000	$\phi 180$	$\phi 60$	13.0	4.0	7.25	12	0.9	TE1204L
TSX-5032	2000	$\phi 180$	$\phi 60$	13.0	8.0	7.25	12.0	1.0	TE1208L
TSX-6035	1000	$\phi 180$	$\phi 60$	17.0	8.0	9.25	16.0	1.5	TE1608L
FA-365	1000	$\phi 180$	$\phi 60$	13.0	8.0	7.25	12.0	1.6	TE1208L
MC-306/30A	3000	$\phi 330$	$\phi 80$ or $\phi 100$	17.5	8.0	9.25	16.0	3.0	TE1608L
MC-405/406	1000	$\phi 330$	$\phi 80$ or $\phi 100$	17.5	8.0	9.25	16.0	3.9	TE1608L
MA-306	3000	$\phi 330$	$\phi 80$ or $\phi 100$	17.5	8.0	9.25	16.0	3.0	TE1608L
MA-406	1000	$\phi 330$	$\phi 80$ or $\phi 100$	25.5	12.0	13.25	24.0	4.0	TE2412L
MA-505/506	1000	$\phi 330$	$\phi 80$ or $\phi 100$	25.5	12.0	13.25	24.0	4.8	TE2412L
NS-32R	4000	$\phi 330$	$\phi 80$ or $\phi 100$	13.5	8.0	7.25	12.0	1.52	TE1208R
FS-335	4000	$\phi 330$	$\phi 80$ or $\phi 100$	13.5	8.0	7.25	12.0	1.52	TE1208R
FS-555	4000	$\phi 330$	$\phi 80$ or $\phi 100$	13.5	8.0	7.25	12.0	2.0	TE1208R
FS-585	4000	$\phi 330$	$\phi 80$ or $\phi 100$	13.5	8.0	7.25	12.0	2.0	TE1208R

## ●Crystal Oscillator

Model	Quantity (pcs/reel)	Reel dimension			Career Tape dimension				Tape type (L=left direction)
		A	B	W	A	B	C	D	
SG-3030/3032/3040JC	1000	φ330	φ80 or φ100	17.5	8.0	9.25	16.0	3.3	TE1608L
SG-3030JF	1000	φ254	φ100	17.5	8.0	9.25	16.0	2.3	TE1608L
SG-3030/3040LC	2000	φ180	φ60	13.0	4.0	7.25	12.0	1.45	TE1204L
SG-350 Series	2000	φ180	φ60	13.0	4.0	3.10	8.0	1.5	TE0804L
SG-550 Series	2000	φ254	φ100	13.4	8.0	7.50	12.0	1.4	TE1208L
SG-310 Series	2000	φ180	φ60	9.0	4.0	5.25	8.0	1.4	TE0804L
SG-645 Series	1000	φ254	φ100	17.5	8.0	9.25	16.0	2.3	TE1608L
SG-710 Series	2000	φ254	φ80	17.5	8.0	9.25	16.0	2.5	TE1608L
SG-636 Series	1000	φ330	φ80 or φ100	17.5	8.0	9.25	16.0	3.3	TE1608L
SG-615 Series	1000	φ330	φ80 or φ100	25.5	12.0	13.25	24.0	4.8	TE2412L
SG-8002LA	2000	φ180	φ60	13.0	4.0	3.10	8.0	1.5	TE0804L
SG-8002LB	2000	φ254	φ100	13.4	8.0	7.50	12.0	1.4	TE1208L
SG-8002CE	2000	φ180	φ60	9.0	4.0	5.25	8.0	1.4	TE0804L
SG-8002JF	1000	φ254	φ100	17.5	8.0	9.25	16.0	2.3	TE1608L
SG-8002CA	1000	φ254	φ100	17.5	8.0	9.25	16.0	2.3	TE1608L
SG-8002JC	1000	φ330	φ80 or φ100	17.5	8.0	9.25	16.0	3.3	TE1608L
SG-8002JA	1000	φ330	φ80 or φ100	25.5	12.0	13.25	24.0	4.8	TE2412L
SG-9001CA	1000	φ254	φ100	17.5	8.0	9.25	16.0	2.3	TE1608L
SG-9001JC	1000	φ330	φ80 or φ100	17.5	8.0	9.25	16.0	3.3	TE1608L
TCO-7106X1A/7107X1A	1000	φ180	φ60	13.0	8.0	7.25	12.0	1.4	TE1208L
TCO-7085 Series	1000	φ180	φ60	13.0	8.0	7.25	12.0	1.4	TE1208L
TCO-7086 Series	1000	φ254	φ100	17.5	8.0	9.25	16.0	2.1	TE1608L
TCO-7087 Series	1000	φ254	φ100	17.5	8.0	9.25	16.0	2.1	TE1608L
TCO-7116H1A	1000	φ254	φ100	17.5	8.0	9.25	16.0	2.1	TE1608L
XG-1000CA	1000	φ254	φ100	17.5	8.0	9.25	16.0	2.3	TE1608L
XG-1000CB	2000	φ254	φ100	13.4	8.0	7.25	12.0	1.95	TE1208L
EG-2000 Series	1000	φ254	φ100	17.5	8.0	9.25	16.0	2.3	TE1608L
HG-2150CA	1000	φ254	φ100	17.5	8.0	9.25	16.0	2.3	TE1608L
HG-8002JA	1000	φ330	φ80 or φ100	25.5	12.0	13.25	24.0	4.8	TE2412L
TCO-391B/C Series	1000	φ330	φ80	25.5	16.0	13.25	24.0	4.2	TE2416L
TCO-393F	500	φ330	φ100	33.5	16.0	3.17	32.0	5.8	TE3216L
TCO-3100 Series	700	φ330	φ80	25.5	16.0	13.25	24.0	5.4	TE2416L
MG-5020JE	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	2.0	TE1612L
MG-5100SA	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	3.65	TE1612L

## ●VCXO

VG-1201CA	1000	φ254	φ100	17.5	8.0	9.25	16.0	2.3	TE1608L
VG-4231CA	1000	φ254	φ100	17.5	8.0	9.25	16.0	2.3	TE1608L
VG-4030JA	1000	φ330	φ80 or φ100	25.5	12.0	13.25	24.0	4.8	TE2412L
VG-2828CB	2000	φ254	φ100	13.4	8.0	7.25	12.0	1.95	TE1208L
TCO-7106Z1Z	1000	φ180	φ60	13.0	8.0	7.25	12.0	1.4	TE1208L
TCO-7116Z1Z4	1000	φ254	φ80	17.5	8.0	9.25	16.0	2.1	TE1608L
TCO-7116X1V	1000	φ330	φ80	17.5	8.0	9.25	16.0	2.1	TE1608L
TCO-291 Series	1000	φ330	φ80	25.5	16.0	13.25	24.0	4.2	TE2416L
TCO-293 Series	500	φ330	φ100	33.5	16.0	3.17	32.0	5.8	TE3216L
TCO-294J	500	φ330	φ80	25.5	12.0	13.25	24.0	2.8	TE2412L
TCO-296 Series	500	φ330	φ80	25.5	12.0	13.25	24.0	2.8	TE2412L
TCO-2000/2100 Series	700	φ330	φ80	25.5	16.0	13.25	24.0	5.4	TE2416L
TCO-2106/2107	700	φ330	φ80	25.5	16.0	13.25	24.0	5.4	TE2416L
TCO-2110 Series /2131	700	φ330	φ80	25.5	16.0	13.25	24.0	5.4	TE2416L
TCO-2152	1000	φ180	φ60	19.4	8.0	9.25	16.0	2.2	TE1608L
TCO-726	500	φ330	φ80	25.5	12.0	13.25	24.0	5.2	TE2412L
TCO-7026X1V2	500	φ330	φ80	25.5	12.0	13.25	24.0	5.2	TE2412L

## ●TCXO

TCO-5890 Series	2000	φ180	φ60	9.0	4.0	5.25	8.0	1.15	TE0804L
TCO-5860 Series	2000	φ180	φ60	9.0	4.0	5.25	8.0	1.4	TE0804L
TCO-5850 Series	2000	φ180	φ60	9.0	4.0	5.25	8.0	1.4	TE0804L
TCO-5060/5160 Series	3000	φ330	φ80	17.5	8.0	9.25	16.0	2.2	TE1608L
TG-5001LA	2000	φ180	φ60	13.0	4.0	5.25	8.0	1.5	TE0804L
TG-5010LH	2000	φ180	φ60	13.0	4.0	5.25	8.0	1.4	TE0804L

## ● Real time clock module

Model	Quantity (pcs/reel)	Reel dimension			Career Tape dimension				Tape type (L=left direction)
		A	B	W	A	B	C	D	
RX-4045SA	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	3.65	TE1612L
RX-4045NB	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	1.8	TE1612L
RX-4581NB	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	1.8	TE1612L
RTC-9701JE	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	2.0	TE1612L
RTC-4701JE	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	2.0	TE1612L
RTC-4701NB	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	1.8	TE1612L
RTC-4574SA	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	3.65	TE1612L
RTC-4574JE	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	2.0	TE1612L
RTC-4574NB	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	1.8	TE1612L
RX-4574LC	2000	φ180	φ60	13.0	4.0	7.25	12.0	1.45	TE1204L
RTC-4543SA	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	3.65	TE1612L
RTC-4543SB	1000	φ330	φ80 or φ100	24.4	12.0	11.50	24.0	2.5	TE2412L
RX-8025SA	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	3.65	TE1612L
RX-8025NB	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	1.8	TE1612L
RX-8581SA	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	3.65	TE1612L
RX-8581JE	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	2.0	TE1612L
RX-8581NB	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	1.8	TE1612L
RTC-8564JE	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	2.0	TE1612L
RTC-8564NB	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	1.8	TE1612L
RX-8564LC	2000	φ180	φ60	13.0	4.0	7.25	12.0	1.45	TE1204L
RTC-7301SF	1000	φ330	φ80 or φ100	17.5	12.0	9.25	16.0	2.4	TE1612L
RTC-62423	1000	φ330	φ80 or φ100	25.5	16.0	13.25	24.0	2.95	TE2416L
RTC-72423	1000	φ330	φ80 or φ100	25.5	16.0	13.25	24.0	2.95	TE2416L

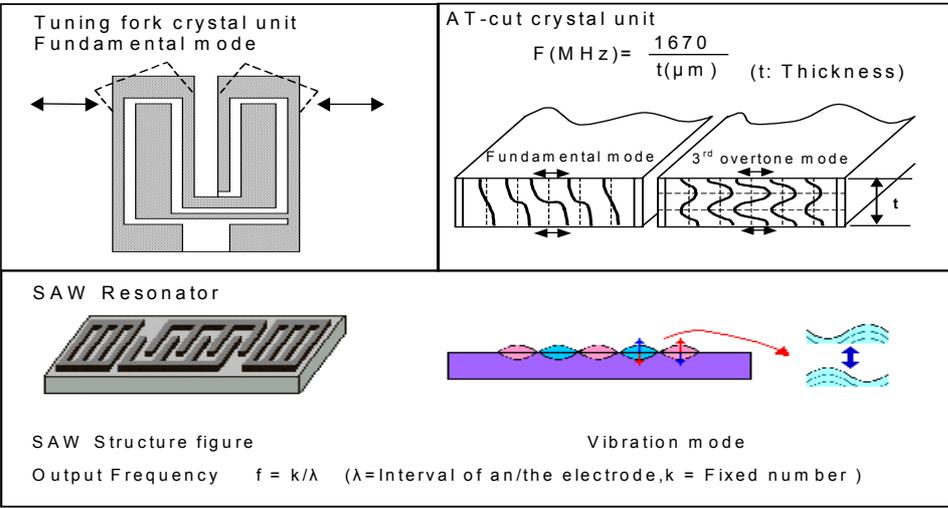
## ● Monolithic Crystal Filter

TF2-D0AD6	3000	φ180	φ60	9	4	5.25	8	1.15	TE0804L
TS3-D0A31	1000	φ180	φ60	13	8	7.25	12	1.35	TE1208L
TF3-J3DC5	2000	φ180	φ60	9	4	5.25	8	1.5	TE0804L
TF3-Q3GC1	2000	φ180	φ60	9	4	5.25	8	1.5	TE0804L
TS2-21B01	1000	φ180	φ60	17	8	9.25	16	1.8	TE1608L
TS2-21B02	1000	φ180	φ60	17	8	9.25	16	1.8	TE1608L
TS2-45A01	1000	φ180	φ60	17	8	9.25	16	1.8	TE1608L
TS3-45A01	1000	φ180	φ60	17	8	9.25	16	1.8	TE1608L
TF3-73BA1	1000	φ180	φ60	17	8	9.25	16	1.8	TE1608L
TF3-73BA2	1000	φ180	φ60	17	8	9.25	16	1.8	TE1608L
TF4-71GX2	400	φ330	φ100	45.5	24	21.95	44	5.4	TE4424L
TF2-W1GC1	2000	φ180	φ60	9	4	5.25	8	1.5	TE0804L

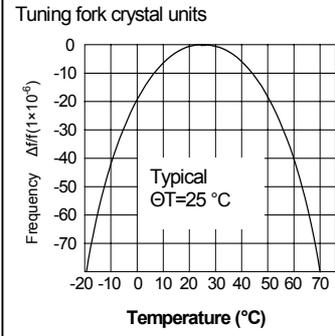
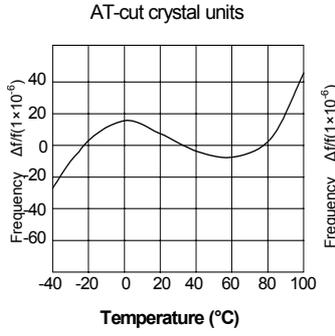
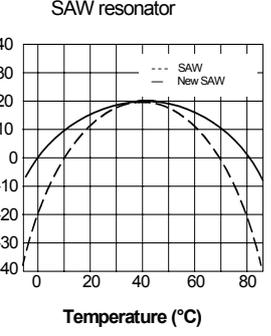
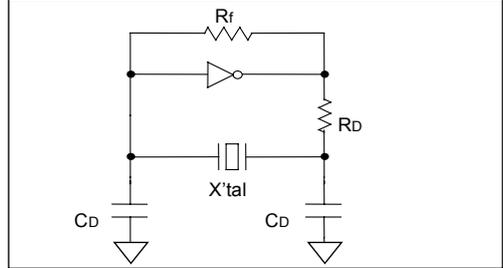
## ● SAW Filter

TQS-535AB-7G	3000	φ180	φ60	9	4	5.25	8	1.5	Individual regulations
TQS-516EA-7G	3000	φ180	φ60	9	4	5.25	8	1.5	TE0804L
TQS-465AA-7R	1000	φ180	φ60	13	8	7.25	12	1.55	TE1208L
TQS-663AA-7R	1000	φ180	φ60	17	12	9.25	16	1.9	TE1612L
TQS-530S-7G	3000	φ180	φ60	9	4	5.25	8	1.5	Individual regulations
TQS-557AA-7R	2000	φ180	φ60	9	4	5.25	8	1.5	Individual regulations
TQS-566AA-7R	2000	φ180	φ60	9	4	5.25	8	1.5	Individual regulations
TQS-542AA-7R	2000	φ180	φ60	9	4	5.25	8	1.5	Individual regulations
TQS-954EA-7R	3000	φ180	φ60	9	4	5.25	8	1.5	Individual regulations
TQS-537AB-7G	3000	φ180	φ60	9	4	5.25	8	1.5	Individual regulations
TQS-457A-7R	1000	φ180	φ60	13	8	7.25	12	1.85	Individual regulations
TQS-471BA-7R	2000	φ180	φ60	9	4	5.25	8	1.5	Individual regulations
TQS-830A-7R	1000	φ180	φ60	13	8	7.25	12	1.85	Individual regulations
TQS-568AA-7R	1000	φ180	φ60	14	8	7.25	12	1.52	Individual regulations
TQS-539A-7G	3000	φ180	φ60	9	4	5.25	8	1.5	Individual regulations
TQS-949AD-7G	3000	φ180	φ60	9	4	5.25	8	1.5	Individual regulations
TQS-565AA-7R	1000	φ180	φ60	14	8	7.25	12	1.52	Individual regulations
TQS-879A-7R	1000	φ180	φ60	14	8	7.25	12	1.52	TE1208R
TQS-472AA-7R	1000	φ180	φ60	17	12	9.25	16	1.9	TE1612L
TQS-477AA-7R	2000	φ180	φ60	9	4	5.25	8	1.5	TE0804R
TQS-570AA-7R	2000	φ180	φ60	9	4	5.25	8	1.5	Individual regulations
TQS-474AA-7R	1000	φ180	φ60	17	12	9.25	16	1.9	TE1612L

# Glossary

Item	Content	Object
Fundamental mode	<p>First harmonic crystal vibration mode. The AT resonance frequency is determined by the thickness of the crystal, but even with the same thickness the third overtone will be about three times the frequency of the fundamental. With tuning fork crystal unit, the second overtone is about six times the fundamental.</p> 	X'tal ,OSC
Divided frequency	The output frequency that is divided by the internal IC.	OSC
Duty (tw/t) (symmetry)	Ratio of full and half cycles. For CMOS loading duty is rated at 1/2 V <sub>cc</sub> , and for TTL loading at 1.4V.	OSC
(Equivalent)series capacitance (C <sub>1</sub> ) (motional capacitance)	Energy distortion to the (equivalent) internal charge capacitance component of the crystal unit, at the series resonant frequency.	X'tal
(Equivalent)series resonant resistance (R <sub>1</sub> )	Vibration loss to the (equivalent) internal charge capacitance component of the crystal unit, at the series resonant frequency. A measure of the easiness of oscillation.	X'tal
Drive level (DL)	Current or voltage level in the oscillating (operating)state.(Drive power= power required to oscillate crystal unit.)	X'tal
Deviation in PB	The difference between the max. and min. attenuations within a pass band.	Filter
Frequency ( f )	Number of waves (cycles)per second. The relation between frequency and cycle is f(Hz)=1/t(s).	ALL
(Frequency )aging (F <sub>age</sub> , F <sub>aging</sub> )	Amount of frequency drift when operated under the specified conditions for a specified term.	ALL
Frequency tolerance precision (F <sub>tol</sub> )	Under specified conditions at an ambient temperature of +25 °C,the difference in actual (measured) frequency from the nominal frequency.	X'tal
Frequency voltage Coefficient	Taking the output frequency at the central voltage in the operating voltage range as the reference, the change in output frequency to voltage. Causes of this change are changes in crystal deformation, and changes in IC internal constants for chips mounted in the oscillator and Real time clock module. The effects of the ICs are larger.	OSC
Frequency tolerance (F <sub>tol</sub> (osc))	Within standard temperature and operational voltage ranges, the drift in the output frequency. The output frequency drift including frequency temperature characteristics and frequency voltage characteristics.	OSC
HFF-XTAL	HFF-XTAL is a high frequency fundamental mode crystal unit using inversed-mesa shape AT-cut blank fabricated with photolithographic technology. Therefore it has an excellent stability for temperature, aging and shock.	OSC

X'tal:Crystal unit, OSC:Crystal oscillator  
More details available on Epson website.

Item	Content	Object
Frequency temperature characteristics	<p>Taking the frequency at 25 degrees Centigrade as the reference, the change in frequency in response to ambient temperature.</p> <ul style="list-style-type: none"> <li>● Tuning fork crystal unit. SAW Resonator.  <math display="block">\Delta f/f = a(\theta T - \theta X)^2</math> <math>\theta X</math>:specified temperature</li> <li>● AT crystal unit.  <math display="block">\Delta f/f = \alpha(\theta X - 25) + \beta(\theta X - 25)^2 + \chi(\theta X - 25)^3</math></li> </ul> <p>Examples of frequency temperature characteristics</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Tuning fork crystal units</p>  </div> <div style="text-align: center;"> <p>AT-cut crystal units</p>  </div> <div style="text-align: center;"> <p>SAW resonator</p>  </div> </div>	ALL
Group delay distortion (Δt)	The difference between the max. and min. group delay within a pass band B1 unless otherwise specified.	Filter
Insulation resistance (IR)	Resistance between lead and lead, or between lead and case package.(conductive package)	ALL
Insertion loss (L)	The logarithmic ratio of the power delivered to the load impedance before insertion of the filter to the power delivered to the load impedance after insertion of the filter.	Filter
Load capacitance (CL)	Effective capacitance (series equivalent charge capacitance) of the oscillation circuit as seen from the pins of the crystal unit. This capacitance is determined as a condition when the crystal unit is connected to the oscillation circuit and will determine the output frequency. Load capacitance approximation:CL	X'tal
Max.drive level (GL)	Rating for the drive level. Current or power input over this level may result in characteristic degradation or destruction.	X'tal
Max. supply voltage (Vcc-GND)	Maximum rated value for power input to the power supply pin. Input over this value may result in characteristic degradation or destruction.	OSC
Max. input level (R)	The max. power that can be delivered to the filter without destructing the filter.	Filter
Nominal frequency( f )	Nominal value of frequency of crystal unit. A frequency given in specification, to which other frequencies may be referred.	X'tal Filter
Operating temperature Range(T_use)	Temperature range where specification characteristics are fulfilled,unless otherwise specified.	ALL
Origin frequency (fo)	Oscillation source frequency of oscillator inside oscillation system.	OSC
Output fall time(tf)	The time it takes for the output wave form to change from the high voltage(high level) to the low voltage(low level). Also called wave form fall time. See waveform diagram under Symmetry.	OSC
Output rise time(tr)	The time it takes for the output wave form to change from the low voltage (low level) to the high voltage (high level). Also called wave form fall time. See wave from diagram under Symmetry.	OSC
Oscillation circuit	<p>Circuit needed to oscillate crystal unit. Circuit Constants will differ with type of crystal unit and frequency.</p> <div style="text-align: center;"> <p><b>Basic oscillation circuit using CMOS IC</b></p>  </div>	X'tal

X'tal:Crystal Unit, OSC:Crystal Oscillator  
 More details available on Epson website.

Item	Content	Object
Oscillation Start up time (tosc)	The time from power on until the wave form stabilizes. However, voltage rise times depend on the power supply, Therefore, the time depends on the power supply, and the time is measured from a specific set of initial conditions.	OSC
Output enable(OE)	Output is switched to high impedance, and wired OR connection can be used to select multiple outputs(frequency).  OE pin: High or open. Specified frequency output = enabled. OE pin: Low. Output is high impedance=disabled. Oscillation is not stopped, so after the clock is disabled, it is not synchronized with OE (clock is continuous).	OSC
Output frequency (fo)	The frequency output from the oscillator circuit or the crystal oscillator system.	OSC
Output load conditions	The types and quantities (power) of the loads that can be connected to the oscillator. Calculated for 1 TTL as IOH = -40 μA, IOL = 1.6 mA and for LS-TTL as IOH = -20 μA, IOL = 0.4 mA.	OSC
Overtone	Vibration state when crystal is vibrating as a high harmonic(see base wavelength). It is harder To match the overtone oscillation circuit with the crystal unit than the fundamental oscillation circuit.	X'tal, OSC
Pass band (BW)	Pass band (BW) A band of frequencies B1 in which the attenuation is equal to or less than a specified value A1 A band of frequencies B1 in which the attenuation is equal to or less than the insertion loss L.  Stop band attenuation Bands of frequencies B2 and B3 in which the attenuations are equal to or greater than specified values A2 and A3 respectively.	Filter
Ripple (R)	The difference between the max. and min. peak attenuation within a pass band.	Filter
Recommended drive level (DL)	Excitation level for optimum oscillation characteristics.	X'tal
Shunt capacitance(Co)	Charge capacitance between the two electrodes in the crystal unit.	X'tal
Soldering conditions (TSOL)	Temperatures or times over these limits may result in characteristic degradation or destruction.	ALL
Stand-by (ST)	Function that halts crystal unit oscillation and frequency Division. Cuts the current consumed by the oscillators circuit and the frequency division stage.  ST pin-high or open: Specified frequency output. ST pin-low: Output is low level, oscillation stops. : Output is low level (weak pull-down), oscillation stops. : Output is high impedance, oscillation stops. Please refer to each data sheet.	OSC
Shortage temperature Range(T_stg)	Maximum absolute rating for the discharged state (no input of voltage, current or power). Exposure to temperatures over this level may result in characteristic degradation or destruction. To assure precision, store at room temperature whenever possible.	ALL
Spurious response A4 (dB)	Min. attenuation caused by extraordinary response in the stop band. Spurious response usually appears at a higher frequency than the center frequency.	Filter
Supply voltage (Vcc)	Voltage input to Vcc pin which will support continuous operation with specification characteristics.	OSC
Terminating impedance (Zt)	Either of the impedances presented to the filter by the source or by the load. (Rt: Resistive portion, Ct: Parallel capacitive portion including stray capacitance)	Filter
VSWR	Voltage Standing Wave Ratio	Filter

X'tal:Crystal Unit, OSC:Crystal Oscillator

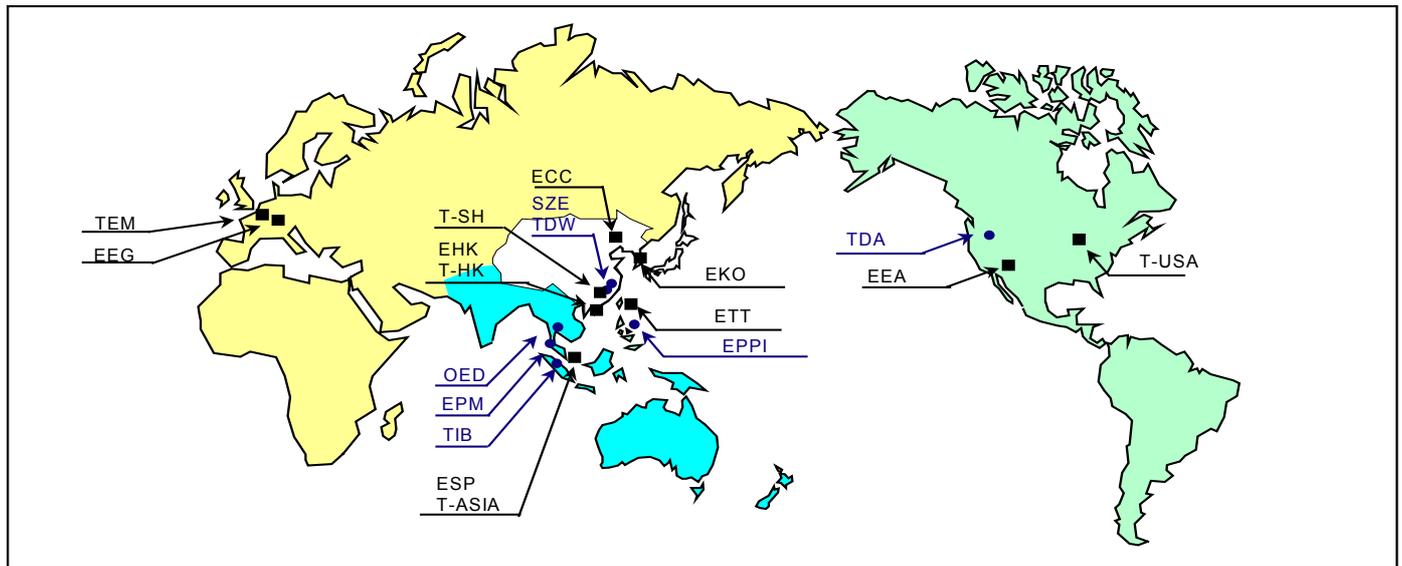
More details available on Epson website.

## Manufacturing Plant

Plant	Date Operations Commenced	Products
Ina Plant	Jun.1959	Crystal unit Crystal oscillator Real time clock module Surface acoustic wave device Sensing device
Shonan Plant	Jun.1963	-
Hobara Plant	Nov.1972	Crystal unit Crystal oscillator Module
Odaka Plant	Jan.1977	Crystal unit Surface acoustic wave device Monolithic crystal filter
Miyazaki Plant	Jun.1984	Synthetic quartz Crystal oscillator Optical device

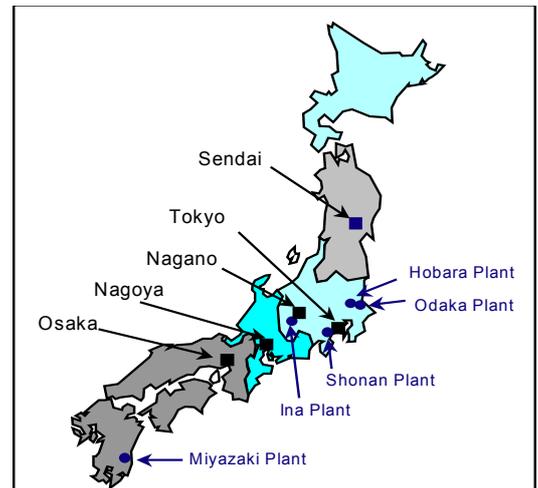
Plant	Date Operations Commenced	Products
EPM: Epson Precision (Malaysia) SDN. BHD. Plant	Dec.1974	Crystal unit Crystal oscillator Real time clock module
OED:Oriental Electronics Device CO.,LTD. Plant	May.1988	Optical device
TIB: PT.Toyocom Indonesia. Plant	Apr.1996	Crystal unit Crystal oscillator
SZE: Suzhou Epson CO.,LTD.Plant	Mar.1997	Crystal unit Crystal oscillator Real time clock module
TDA:Toyocom Devices of America,inc. Plant	Jun.2000	Synthetic quartz
TDW:Toyocom Devices(WUXI)CO.,LTD. Plant	Jul.2001	Crystal unit Optical device
EPPI:Epson Precision (Philippines) Inc. Plant	Feb.2002	Crystal unit

## Business area



EEA : Epson Electronics America,Inc.  
 EEG :Epson Europe Electronics GmbH  
 EHK :Epson Hong Kong Ltd.  
 ETT :Epson Taiwan Technology & Trading Ltd.  
 ESP :Epson Singapore Pte.Ltd.  
 ECC :Epson (China) Co.,Ltd.  
 EKO :Seiko Epson Corp. Korea Office

TEM :Toyocom Europe GmbH  
 T-USA :Toyocom U.S.A.,Inc.  
 T-ASIA :Toyocom Asia Pte.Ltd.  
 T-HK:Toyocom Hong Kong Ltd.  
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